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CONTROLITE 1.0
LIGHTING CONTROL SYSTEMS AND DAYLIGHTING ANALYSIS PROGRAM:
USER'S MANUAL*

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Preface

This user's manual explains how to work with the CONTROLITE lighting control system analysis program on your IBM Personal Computer. It contains:

- A listing of what you need to use the CONTROLITE system
- Instructions on how to get started
- Details of all features of the CONTROLITE system
- Example problems to help you learn how to use the program

The CONTROLITE manual assumes that you have read and are familiar with the "IBM Personal Computer Guide to Operations", Section 2 in particular.

1.0 Program Overview

1.1 Introduction

In theory, a lighting control system which continuously monitors the available artificial and natural light within a space and supplies only the power required to provide light to meet some specified criteria illuminance level, and no more, should be able to optimize the energy savings capabilities of that lighting control system. Because of the potential for constantly varying power consumption due to this Equi-Illumination Dimming (EID) system, the computer is employed to help in modeling their preformance.

This computer program, CONTROLITE, provides an unbiased mathematical model from which comparisons can be made, on an economic basis only, of how different systems perform. The program has the option of calculating daylighting values, or allowing the user to specify the daylighting values as input. Calculations can also be done on simple control systems which do not respond to daylighting.

For purposes of allowing for the calculating of daylighting values, program CONTROLITE is augmented with an accurate yet quick subprogram QUICKLITE. QUICKLITE employs what is known as the daylight factor method for calculation of daylighting values.

In addition to invoking QUICKLITE to provide data to CONTROLITE, QUICKLITE may be executed by itself to allow the user to perform interior daylighting calculations.

The CONTROLITE program analyses control schemes exclusively on an economic basis, considering only the energy consumed directly by the lighting system. No attempt has been made to account for any additional savings realized in HVAC systems when lighting systems are controlled. The program makes no statement about the user acceptance of lighting control systems or about the aesthetic qualities of the use of daylighting within interior spaces.

Lawrence Berkeley Laboratory assumes no responsibility for the validity, accuracy, or applicability of any of the results obtained from the CONTROLITE lighting control system analysis program.

Lawrence Berkeley Laboratory is attempting to make the CONTROLITE programs comprehensive and easy to use as possible. Any comments, suggestions or errors encountered in either the results or documentation should be brought to our attention.

1.2 Program Capabilities

The major capabilities of CONTROLITE lighting control system analysis program include:

a. Modeling of continuous or stepped control systems.

b. Modeling of linear or non linear light output vs. power input relationships.

c. Manual input of daylighting illuminance levels.

d. Automatic calculation of daylighting illuminance levels.

e. Calculation and reporting of daylighting illuminance values.

f. Reporting the effect of maintenance factors over the cleaning cycle.

g. Economic analysis of lighting control systems.

The major capabilities of the QUICKLITE daylighting analysis portion of the CONTROLITE system are:

h. Modeling up to ten windows in a room.

i. Calculating daylight illuminance on a grid of up to ten rows and ten columns of analysis points.

j. Calculating daylight illuminance for any time of day , any day of the year at any location on Earth.

k. Model overcast, clear and uniform sky conditions.

1.3 What you need to run CONTROLITE

To insure proper program operation and full use of all the features and capabilities of the CONTROLITE system, you should have the following:

- IBM Personal Computer, IBM PC/XT or fully compatible microcomputer configured as below:
  - IBM System Unit with 2 diskette drives or 1 diskette drive and a hard disk
  - Expanded internal memory to at least 256 K.
  - 80 column monitor
  - PC-DOS Disk Operating System (2.0 or current upgrade).
  - 8087 Numerical Data Processor chip: "Coprocessor" (optional but strongly recommended)
- CONTROLITE user's manual and master program diskettes. The following two diskettes comprise the CONTROLITE system:
  - Data Input (Master and Back-up diskettes)
  - Calculation/Output
- A sufficient number of blank diskettes for master program diskette back-up and data storage.

1.4 Getting Started

This manual, together with the two program diskettes you have received, provide all the information which is needed to operate the CONTROLITE system successfully, and to have it become a useful tool in your lighting control design and analysis work. This manual is not intended to teach you about the use of the IBM Personal Computer or the fine points of microcomputer technology. Consequently, when you read in this manual to "input filename", or to "back-up your master diskettes", it is assumed that you know how to do this or will refer to other appropriate documentation for instructions.

1.4.1 Master Program Diskettes

The two diskettes included as part of the CONTROLITE package contain separate program modules of the CONTROLITE system. Both are needed and must be carefully protected to insure continued proper operation of the system.

Before attempting to run CONTROLITE , it is important that you do the following:

1) Make a copy of each CONTROLITE diskette which you have received. This copied set of diskettes should be used as the 'run-version', while the master set serves as a back-up and should be stored in a safe place. Refer to the IBM DOS manual for information on formatting and copying your program diskettes. Store master diskettes in a safe place where they will not be damaged or used frequently.

   Note: All diskettes used to back-up the master program diskettes should be double-sided, double-density diskettes.

2) Make the following changes to the run-version set of diskettes:

   Copy COMMAND.COM from the DOS diskette to the Data Input diskette plus at least one additional blank formatted data diskette and one scratch diskette. With DOS in drive A and the appropriate diskette in drive B, type: 'COPY COMMAND.COM B:'.

All master diskettes have been tested prior to shipment and should work properly. If you suspect that any of the master diskettes you received have been damaged, contact Lawrence Berkeley Laboratories.

For the remainder of this manual, references to a specific program diskette will be assumed to be your run-version of that diskette.

1.4.2 Additional Diskettes

In addition to the two CONTROLITE program diskettes, you will need at least one additional blank diskette which will be used to store analysis program input, and one scratch diskette to be used in Drive B while the analysis programs are running. The diskettes you use for these purposes need not be blank initially, although it is recommended.

1.4.3 Using this Manual

Each of the remaining chapters of this manual contains information concerning the operation of CONTROLITE. Chapter 2 discusses the concept of the data input worksheet and ways to manipulate it on the screen. The options of the CONTROLITE Activity Menu are discussed in Chapter 3, while Chapter 4 contains a discussion of how to run a CONTROLITE analysis, and describes in detail each item present in the input worksheet. Example problems with typical control systems are used to highlight the main features of the program, and can be found in Appendix A.

It is recommended that you follow through the examples discussed in Chapter 4 and Appendix A before proceeding to your own work. Once you are familiar with the structure and terminology of the system, this manual will become a reference document and can be reviewed for specific information on the necessary topic of interest.

After you have made copies of the master program diskettes and have prepared separate diskettes for data input files and scratch files, proceed to Chapter 2 for a discussion of the data input worksheet.

Note: The operation of the program presented in the following chapters is for use with an IBM/PC that is configured with 2 "soft" diskette drives. Certain economies and conveniences are available with CONTROLITE if it is run on a hard disk. For an explanation of the program differences on hard disk systems, refer to Appendix B.

2.0 Data Input Techniques

The input data which describes the system to be analyzed, the types of analysis to be done, the output to be printed, etc., are all stored in a CONTROLITE data input file. Each data input file can be named and stored to a diskette, and numerous files may be stored on the same diskette.

Creating a data input file is accomplished using the CONTROLITE Data Input diskette. The information necessary to describe a lighting control system is supplied to a data input worksheet which then can be saved to a diskette. Moving around the data input worksheet on the screen is made simple by single keystrokes on the IBM/PC keyboard.

This chapter will introduce you to the CONTROLITE data input program and will discuss the activities involved in creating and saving a data input file.

Note: All information in this manual which appears on the screen will be shown in bold typeface to help distinguish the screen display from descriptive text.

2.1 Preparing Your IBM/PC

To begin, your IBM/PC must first be on and at the system prompt A>. The correct date and time should have been entered to the machine at boot time so that all files will be properly recorded on the diskette directory. To start the program, insert the Data Input diskette into Drive A and type 'LUMEN-C' after the A> prompt. The program title will appear and the following instructions will be printed at the bottom of the screen:

Insert CONTROLITE Input File Diskette into Drive B:
Press any Key to Continue.

If this is the first time you have run this program, insert a blank formatted diskette into Drive B. This diskette will serve as your CONTROLITE data input file diskette. (Be sure to label this diskette and take the necessary backup precautions once you have created and saved any input files on this diskette.)

2.2 Introducing the Activity Menu

After you have loaded an input file diskette into drive B, press the [Enter] key to move ahead to the CONTROLITE Activity Menu.

The menu will be displayed on the screen:

CONTROLITE ACTIVITY MENU

1 Create New Input File
2 Edit Existing File & Resave
3 Edit Existing File & Rename
4 Print Existing File
5 Print Blank Worksheet
6 Erase Existing File
7 View Input File Directory
8 Run CONTROLITE
9 End Program

Enter Selection Number [ ]

For the purpose of this discussion, we will choose Activity 1 to "create a new input file" from a blank input worksheet. For a complete discussion of all of the activities in the Activity Menu, refer to Chapter 3.

2.3 The Blank Worksheet

Select Activity 1, 'Create New Input File' to bring a blank input worksheet to the screen. After typing the activity number and supplying a file name to be used, press [Enter]. A portion of the blank worksheet will then be displayed on the screen. The top 24 lines of the screen will appear as shown:

The bottom line of the screen is not part of the data input worksheet. This line serves to indicate the status of keys that can be toggled into activity and have an effect on user input, namely [Caps Lock] and [Num Lock].

2.3.1 The Screen as a Window

Although a data input worksheet for CONTROLITE can be over 500 lines long, only 24 lines can be displayed on the screen at any one time. Any group of 24 lines which appears on the screen will be referred to as a page of the input worksheet. The screen can be thought of as a "window" which the user directs to look at different sections of the entire worksheet.

The name "worksheet" refers to the collection of pages being displayed and manipulated on the screen by the various keys on the keyboard. A worksheet may be blank, or it may be a file which has been retrieved from a diskette and is being altered. When an existing input file is being displayed on the screen using menu activity 2 or 3, that file becomes the "current worksheet". Any data that is entered to the current worksheet is not permanent until it is saved onto a diskette.

2.4 Entering Data

After a page of the worksheet has been displayed on the screen, the cursor will be placed between the pair of brackets '[ ]' in the upper left hand portion of the screen. The cursor indicates the position where a character will be located if a key is pressed. The cursor used for data input for CONTROLITE has been made larger than the normal cursor used on the IBM/PC so that it is easier to locate on the screen.

Each area enclosed within a set of brackets '[ ]' is called an input cell. The cursor is controlled by the program in such a way that it can only be moved within an input cell, or from cell to cell within the worksheet. The remaining portion of the input worksheet serves to document the contents of each cell, and cannot be modified by the user.

When possible, the input worksheet will prohibit you from inputting characters which are not valid for that cell. For example, the input to the cell for rated lumens must be numeric, therefore the alphabetic keys on the keyboard will be disabled when the cursor is located in this cell.

If the number of characters that you try to type into a cell exceeds the width of that cell, the cursor will remain at the far right edge of the cell and a tone will sound for each additional key that is pressed. Use the backspace key or the [F7] key (as discussed in the next section) to correct the contents of the cell.

2.5 Data Input and Screen Control

Manipulation of the cursor position, control of the page of the worksheet being displayed on the screen, and editing of data stored in individual cells is performed with the Function Keys on the left side of the IBM/PC keyboard, and the Cursor Control Keys in the Numeric Key Pad on the right side. The Numeric Key Pad may be used in either of two modes. If Num-Lock is on, then these keys function as numeric keys. If Num-Lock is off, however, these keys can be used to quickly manipulate the page of the worksheet being displayed on the screen, as well as the input cell position of the cursor on the screen.

In the key definitions to follow, if keys are shown separated by a comma, then either key will invoke the function described. If two keys are shown separated by a hyphen, then both keys must be pressed at the same time to invoke that function.

[?] (Summary of Worksheet Commands)

The [?] is one of the most important keys to remember in the CONTROLITE system. Pressing this key (which must be done using the [Shift] key) will display a list of all of the various function keys, and the actions that have been assigned to each. If you ever forget what key or keys perform a certain function, just type [?]. The following help screen will then appear:

```
[F2]=[Home]=Window to top of worksheet
[F3]=[Scroll Lock]-[↓]=Window down one line
[F4]=[Scroll Lock]-[↑]=Window up one line
[F5]=[PgDn]=Window down one page (24 lines)
[F6]=[PgUp]=Window up one page (24 lines)
[F7]=Blank out cell at current cursor position
[F8]=Move cursor one space to the right in current cell
[Alt]-[F3]=[↓]=Move cursor down one line
[Alt]-[F4]=[↑]=Move cursor up one line
[Alt]-[F7]=Blank out all cells on current line
[Tab]=[←]=Move cursor back one cell
[Enter]=[→]=Move cursor forward one cell
[End]=Window to bottom of worksheet
[Alt]-[S]=Save current worksheet and return to menu
[Alt]-[M]=Return to menu - current worksheet not saved
    Press [Esc] Key to Return to Input Worksheet
```

It may be helpful to make a copy of the above list so that you can have a permanent printed copy of these functions for easy reference during data entry.

[→] , [Enter] (Next Cell)

These keys will move the cursor forward from cell to cell, from left to right and from top to bottom across the screen. When the cursor is located at the last cell in the current page of the worksheet, pressing either will return the cursor to the top left most cell on that page.

[←] , [Tab] (Previous Cell)

These keys will move the cursor backward from cell to cell, from right to left and from bottom to top across the screen. When the cursor is located at the first cell on the current page of the worksheet, pressing either will move the cursor to the bottom right most cell on that page.

[F2] , [Home] (First Page)

These keys will move the display window to the first page (first 24 lines) of the current worksheet.

[End] (Last Page)

This key will move the display window to the last page (last 24 lines) of the current worksheet.

[F3] , [Scroll Lock]-[↓] (Line Down)

These keys will move the display window down one line. The top line on the page will scroll off the screen and one new line will be added to the bottom of the screen. The cursor will remain in the cell in which it is currently located. If the cursor is at the top line of the page before [F3] is pressed, the cursor will move to the top left most cell on the screen after scrolling takes place.

[F4] , [Scroll Lock]-[↑] (Line Up)

These keys will move the display window up one line. The bottom line on the page will scroll off the screen and one new line will be added at the top of the page. The cursor will remain in the cell in which it is currently located. If the cursor is at the bottom line of the page before [F4] is pressed, the cursor will move to the bottom left most cell on the screen after scrolling takes place.

[F5] , [PgDn] (Page Down)

These keys will move the display window down one page. The next 24 lines of the worksheet will be displayed on the screen, and the cursor will be placed in the top left most cell on that page.

[F6] , [PgUp] (Page Up)

These keys will move the display window up one page. The previous 24 lines of the worksheet will be displayed on the screen, and the cursor will be placed in the top left most cell on that page.

[F7] (Blank current cell)

[F7] will blank out the contents of the cell where the cursor is currently located. This feature is helpful for editing existing files or for getting a clean start if a typing error has been made in a cell entry. The cursor will be moved to the left most position in the cell after the contents of the cell have been erased.

[F8] (Cursor Right)

This key will move the cursor to the right within a cell, one character position at a time. This key is not active when the cursor is located in a cell used to specify a file name, so that invalid DOS file names which have blank characters will not be created accidently.

[↓] , [Alt]-[F3] (Cursor Down One Line)

Either of these keys will move the cursor down one line. The cursor position in the new line will correspond to its previous position in the old line, if possible. For example, if the cursor is in the second cell on a particular line when this key is pressed, the cursor will be placed in the second cell on the line below, unless there are fewer than two cells on that line. In the case where there are fewer cells in a new line than the number of the cell in which the cursor was originally positioned, the cursor will be placed in the first cell on the new line. Also, When the cursor is located on the last line of a page, striking [↓] or [Alt]-[F3] will place the cursor in the appropriate cell on the first line of the current page.

[↑] , [Alt]-[F4] (Cursor Up One Line)

Either of these keys will move the cursor up one line. The cursor position in the new line will correspond to its previous position in the old line, if possible. For example, if the cursor is in the second cell on a particular line when this key is pressed, the cursor will be placed in the second cell on the line above, unless there are fewer than two cells on that line. In the case where there are fewer cells in a new line than the number of the cell in which the cursor was originally positioned, the cursor will be placed in the first cell on the new line.

Also, When the cursor is located on the first line of a page, striking [↑] or [Alt]-[F4] will place the cursor in the appropriate cell on the last line of the current page.

[Alt]-[F7] (Blank All Cells in the Current Line)

This key combination will blank out the contents of all the cells on the line where the cursor is currently located. This feature is helpful for editing existing files or for getting a clean start if a typing error has been made in a line of cells. The cursor will be moved to the left most cell after the contents of all of the cells have been erased.

[Backspace] (Backspace)

This key can be used to backspace one character at a time within a cell. The cursor will only back up as far as the first character position in any cell.

2.6 Expanding the Worksheet

In Section 2.3, it was described how a blank worksheet can be brought to the screen using Activity Menu item number 1. If you actually selected this activity on your computer, you may have noticed that in some instances the cells in the blank (or default) worksheet actually contain a number. Each cell in the worksheet which already has a number stored in it is capable of expanding the worksheet to allow for additional input. The values initially supplied in these cells construct the simplest worksheet possible; more complex worksheets can be created by changing these numbers.

There are eleven different locations in the worksheet where a value is already provided to a cell or group of similar cells. These decision cells relate to the following sections of input within the CONTROLITE worksheet:

QUICKLITE DAYLIGHTING ANALYSIS (X): [X]

Number of Windows (1-10): [1]

Explicit Solar Information (X): [X]

CONTROLITE ENERGY ANALYSIS (X): [X]

Number of Different Daily Control Schemes (1-7): [1]

Number of Time Blocks With a Specific Illuminance (1-5): [0]

Number of Time Blocks with Different Cost/KWH (0-3): [0]

Number of Steps or Ordered Pairs (2-15): [2]

Daylighting Analysis (X): [X]

Window Activity Schedule (X): [X]

Number of Heading Lines: [1]

Each of these options will be discussed in Chapter 4 with respect to how they affect the appearance of the worksheet.

The data input to the numerous decision cells in the sections described above determines how much of the input worksheet will be displayed. A typical blank worksheet has the minimum amount of input displayed. It is possible to create an expanded blank

worksheet if it is more helpful than the minimum blank worksheet available through Activity Menu 1. By modifying the decision lines and saving this modified worksheet to a file (as discussed in the next section), an expanded worksheet can be created to fit your particular needs. In addition, heading lines which are common to all CONTROLITE output reports can be stored as part of this worksheet.

The values in the decision cells control the display of the worksheet on the screen, but do not actually erase the data in the lines that have been removed from the screen until the file is saved to a diskette. Once a file is saved, however, those lines that were hidden by altering the decision cells will be erased.

Note: If the value input to a decision cell is out of the range of acceptable values, the program will treat that value as being the default value initially supplied in the cell.

2.7 Saving Worksheets to a Data Input File

All of the screen manipulation and data input which has been discussed in the previous sections relate to the worksheet as it apppears on the screen. Until this worksheet is saved to a file on your input file diskette, these changes are not permanent. If by some accident your machine is turned off or otherwise disturbed during an editing session, all changes made to the worksheet will be lost.

2.7.1 [Alt]-[S]

If you are editing a new or existing worksheet and wish to save that worksheet to a permanent file on your diskette, type [Alt]-[S]. [Alt]-[S] means press the [S] key while the [Alt] key is held down. The screen will be cleared and the message '*WRITING INPUT FILE TO DISK*' will be displayed. When the complete file has been saved to your input file diskette, the program will return you to the Activity Menu for further processing. [Alt]-[S] may be typed at any time during an input session.

If there is insufficient room on the diskette to store the input file, a message will appear on the screen and you will be instructed to insert another diskette into drive B, to which the file can be saved.

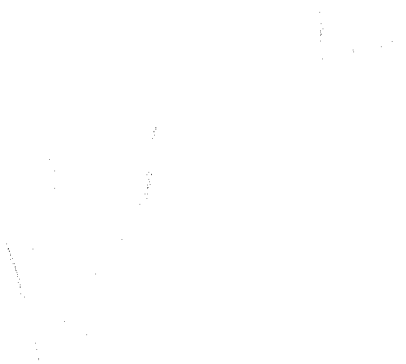
2.7.2 [Alt]-[M]

If you do not wish to save the worksheet that you have been editing, and would like to return to the Activity Menu, type [Alt]-[M]. At the bottom of the screen the following question will appear:

Are you sure (y/n)? [ ]

Answering yes, with the input of 'Y' to the query cell, will return you immediately to the Activity Menu for further processing without saving any of the input or changes that you may have made to the worksheet. Answering no, with the input of 'N' to the query cell, will cancel the return to menu command.

[Alt]-[M] can also be used to cancel a menu item if the cursor is still located on the Activity Menu page. This can be done by typing an [Alt]-[M] during any of the additional prompts that may appear on the screen. This may be helpful if you discover that the wrong activity has been selected, or that an incorrect response has been provided for one of the prompts for a particular menu item.



3.0 The Activity Menu

As introduced in Chapter 2, the various tasks of creating new input files, editing existing files, running the analysis programs, etc. are all accomplished by selecting the appropriate activity from a main Activity Menu which is displayed on the screen as shown below.

CONTROLITE ACTIVITY MENU

1 Create New Input File
2 Edit Existing File & Resave
3 Edit Existing File & Rename
4 Print Existing File
5 Print Blank Worksheet
6 Erase Existing Input File
7 View Input File Directory
8 Run CONTROLITE
9 End Program

Enter Selection Number [ ]

The remainder of this chapter will discuss each of these activities in more detail.

3.1 Create New Input File

This activity will bring a blank input worksheet to the screen so that a new input file can be created and stored for use by the CONTROLITE analysis programs. The following prompt will appear if this activity is selected:

New File Name [ ].LCI

After entering the name to be used for this new file, press [Enter] and within seconds the first page of the blank worksheet will appear on the screen. You can then proceed to fill in the worksheet and create the new input file as discussed in Chapters 2 and 4. The program will automatically add the file extension '.LCI' to every input file which is created. All CONTROLITE data input files must have this extension. If you supply a file name which already exists on the input file diskette, an error message will appear and the program will return to the Activity Menu where you can attempt this activity again using a different file name.

Remember to type [Alt]-[S] after data input is complete if you want this file to be saved permanently under the name which was supplied.

3.2 Edit Existing File & Resave

This activity will bring an existing CONTROLITE input file to the screen for editing. After editing is complete, the file will be resaved under the current file name. The following prompt will appear if this activity is selected:

```
Existing File Name  [        ].LCI
```

After entering the name of the existing file, press [Enter] and the screen will display:

GETTING INPUT FILE FROM DISK

After a short delay the file will appear on the screen and you can proceed to make the needed editing changes to the file. Type [Alt]-[S] after editing is complete if you want this modified file to be saved permanently under the current file name.

If the file name which is supplied is not on the diskette in drive B, the program will issue a tone and the message 'Error: File not Found - Press Enter Key to Return to Menu' will appear at the bottom of the screen.

3.3 Edit Existing File & Rename

This activity will bring an existing CONTROLITE input file to the screen for editing. After editing is complete, the file will be saved under a different file name. The following prompts will appear if this activity is selected:

```
Existing File Name  [        ].LCI
     New File Name  [        ].LCI
```

After entering the names of the existing and new files, press [Enter] and the screen will display:

GETTING INPUT FILE FROM DISK

After a short delay the existing file will appear on the screen and you can proceed to make the needed editing changes to the file. Type [Alt]-[S] after editing is complete to save this modified file under the new file name.

If the file name which is supplied is not on the diskette in drive B, the program will issue a tone and the message 'Error: File not Found - Press Enter Key to Return to Menu' will appear at the bottom of the screen.

Note: The existing file which was edited will not be erased from the diskette using this activity. See Section 3.6 for a discussion on erasing existing input files.

3.4 Print Existing File

Use this activity to print the contents of an existing input file on your printer. The following prompt will appear when this activity is selected:

Existing File Name [ ].LCI

After entering the name of the existing file to be printed and pressing the [Enter] key, the message 'Turn Printer on, Set Paper to Top of Form, and Press any Key to Continue' will appear at the bottom of the screen. The paper on the printer should be advanced to the top of a new page, since printing will begin at the current line on the printer.

3.5 Print Blank Worksheet

Use this activity to make a hard-copy of a blank worksheet on your printer. The worksheet which will be printed is the minimum allowable worksheet for a valid CONTROLITE analysis, and is the same worksheet that is used in Activity Menu #1 for creating a new input file. After selecting this activity, a message will appear on the screen instructing you to set the paper on the printer to the top of a new page, since printing will begin at the current line on the printer.

3.6 Erase Existing File

Use this activity to erase existing CONTROLITE input files from your diskette if they are no longer needed. This activity performs the same function as the DOS 'ERASE FILENAME' command. The following prompt will appear if this activity is selected:

Existing File Name [ ].LCI

After supplying the proper file name, you will be asked 'Are You Sure (Y/N)? [ ]' to reconfirm your desire to delete the existing input file. An 'N' response will return you immediately to the Activity Menu. A 'Y' response will cause the program to delete the named file from the diskette before returning to the Activity Menu.

3.7 View Input File Directory

If this activity is selected, a directory will be shown on the screen of all CONTROLITE input files that are stored on the diskette in drive B. All of these files end with the file extension '.LCI' which is supplied automatically by the program. Several input file diskettes may be reviewed by simply changing the diskette in drive B when at the Activity Menu prompt.

When this activity is selected, the directory will appear at the bottom of the screen as shown below:

FILENAM1.LCI FILENAM2.LCI FILENAM3.LCI

Press Any Key to Return to Menu

3.8 Run CONTROLITE

Select this activity to run the analysis programs using an existing input file which has already been created and saved on the diskette in drive B. If your IBM/PC has a hard disk, multiple runs can be made by specifying the total number of runs to be made and by providing the input and error file names for each run.

Refer to Chapter 4 for a full discussion of how to run a CONTROLITE analysis.

3.9 End Program

This activity should be selected to end the program and return to the DOS SYSTEM level. The screen will be cleared and the 'A>' prompt will appear at the top of the screen.

3.10 Special Features

Remember that [Alt]-[M] can be used to cancel a menu item if the cursor is still located on the Activity Menu page. This may be helpful if you discover that the wrong activity has been selected or that an incorrect response has been provided for one of the prompts for a particular menu item.

The [F7] key is also active when the Activity Menu is displayed on the screen, and if pressed, will blank out the contents of the cell in which the cursor is located.

The name of the input file which you supply when selecting any menu item will be temporarily stored by the program, and can be reused in an input file cell by simply typing [Enter] when the next prompt appears. For example, if you have just completed Activity 2 on file 'TESTER' and wish to run the analysis programs, select Activity 8 and press [Enter] when the prompt 'Input File Name [ ].LCI' appears. The program will automatically put 'TESTER' in the cell for you.

4.0 CONTROLITE ANALYSIS PROGRAMS

Chapters 2 and 3 discussed the capabilities and use of the data input worksheet and the Activity Menu. This chapter will discuss the purpose and use of the various diskettes which you have received. These diskettes have been referred to as the analysis programs and are the heart of the CONTROLITE system.

The analysis programs can be divided into two separate sections, 1) Data Input and Data Checking, and 2) Analysis and Output. Each of these will be discussed further throughout this chapter.

4.1 Running the Program

To assist you in understanding the capabilities and use of the analysis programs, an example will be used throughout this chapter to show the creation of a typical input file, the submission of that file for data checking and analysis, and the resulting output. It will be helpful in your understanding if you follow along, entering the data shown, and then run the program as you work your way through this chapter.

4.2 Preparing your IBM/PC

As discussed in chapter two, your IBM/PC must be turned on and at the system level A> prompt before you can begin CONTROLITE (hard disk users refer to appendix B). To start the program, insert the Data Input diskette into drive A and type 'LUMEN-C' after the A> prompt. The program title will appear along with the following message:

```
Insert CONTROLITE Input File Diskette into Drive B:
          Press any Key to Continue.
```

If this is the first time you have run this program, insert a DOS formatted blank diskette into drive B. This diskette can serve as your CONTROLITE data input file diskette, on which input files for the program can be stored. (Be sure to label this diskette and take the necessary backup precautions once you have created and saved any input files on it.) After inserting the diskette into drive B, press [Enter] and the main Activity Menu will appear.

4.3 Data Input for Analysis Programs

The first functional part of the analysis programs involves the input of data describing the daylighting parameters to be analyzed and the control system to be evaluated. All of this information is entered to a data input worksheet using the Data Input diskette.

A CONTROLITE data input worksheet consists of up to seven major sections:

- Daylighting Analysis (QUICKLITE)
- Control Strategies
- Control System Characteristics
- Daylighting Illuminance Data
- Electric Lighting Illuminance Data
- Economic Data
- Output Information

Each of these sections will be discussed in the remainder of this chapter.

4.3.1 Format and Conventions

The coordinate system used to indicate locations and directions is the cartesian coordinate system shown in Figure 4.1. The cardinal directions of North, South, East and West correspond to the +Y, -Y, +X and -X directions respectively. Height corresponds to the +Z direction.

Elevation and Azimuth angles are expressed in decimal degrees (not minutes and seconds) as shown in Figure 4.2. Elevation is measured up from the horizon (0-90 degrees). Azimuth is measured from South, positive in the Westerly direction (0 to 180 degrees) and negative in the Easterly direction (0 to -180 degrees).

The English system of dimensions are used, with linear dimensions in feet, illuminance in footcandles, and power in watts. Reflectance and transmittance are expressed in terms of decimal fractions (0-1.0) not percentages (0-100%).

Time is expressed as hours on a twenty four hour clock (0-24) and minutes (0-60) seperated with a decimal point. Twenty five minutes after two in the afternoon would be expressed as 14.25 .

There are several input cells where no number is required, only an acknowledgement. Such acknowledgements are made by placing an 'X' in the cell.

Throughout this chapter, lines that are printed in bold type are lines that appear on the display. Characters that are underlined are those that are to be input by the user.

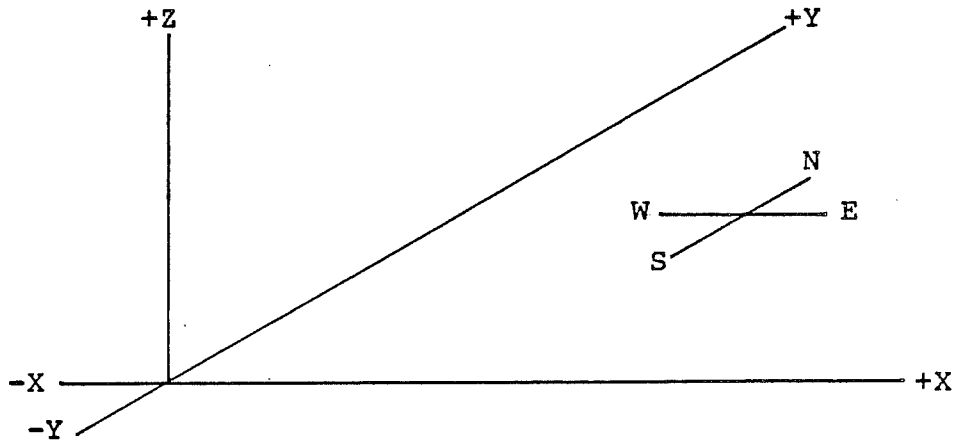


Figure 4.1
Cartesian coordinate system and Cardinal directions.

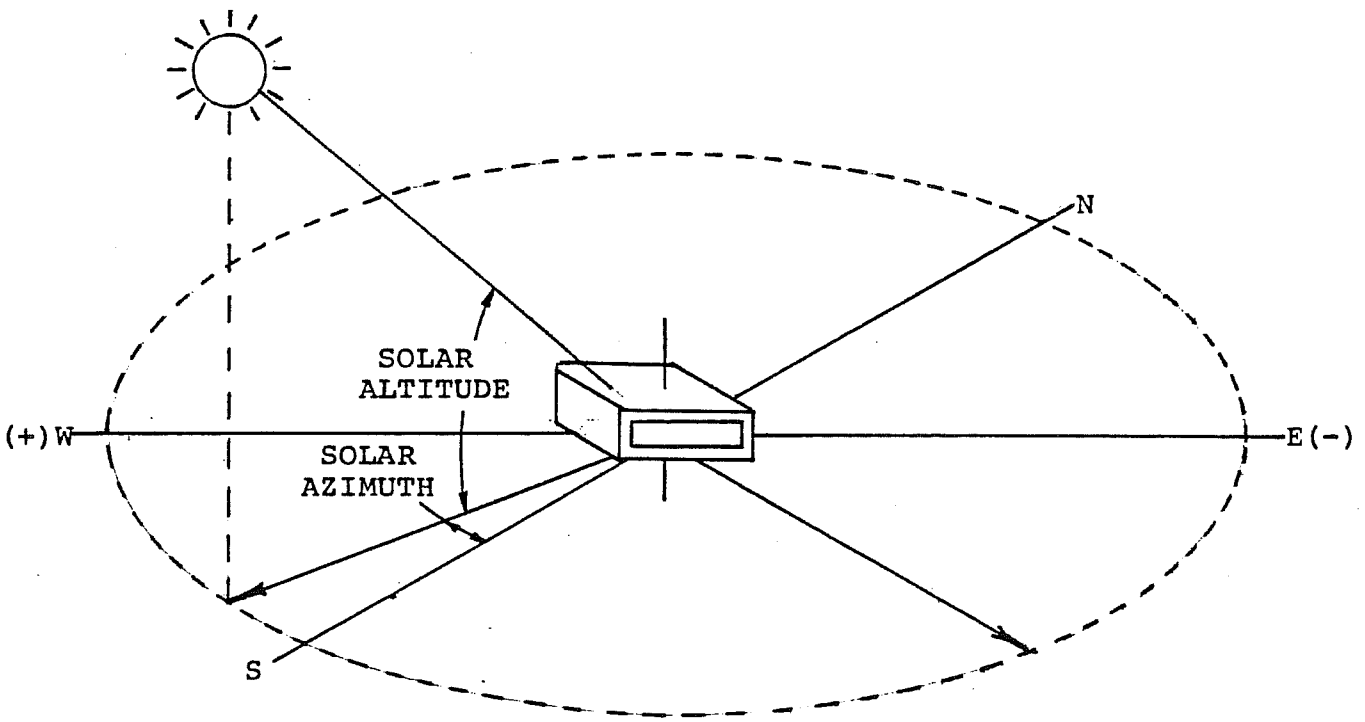


Figure 4.2
Altitude and Azimuth conventions.

4.4 The Data Input Worksheet

We are now ready to begin discussing the actual input data that is required. Select Activity Menu item number 1 - 'Create New Input File' by typing a '1' and then pressing the [Enter] key.

Input File [Example].LCI

The program will then prompt for a name for the input file. In this case we name the file 'Example '. The filename extension of .LCI identifies this file as being a CONTROLITE Data Input File and is placed there automatically by the program.

----------QUICKLITE----------

This line identifies the next group of input lines as belonging to QUICKLITE, the automatic daylight calculation portion of this program.

QUICKLITE DAYLIGHTING ANALYSIS (X): [X]

An 'X' in this input cell acknowledges that it is your intention to run QUICKLITE either alone or in conjunction with CONTROLITE to compute the required daylighting illuminance values.

If this cell were left blank (indicating that QUICKLITE was not to be run), none of the following input cells pertaining to QUICKLITE would be displayed on the worksheet. If an 'X' is placed in this cell, then the numerous QUICKLITE input lines which follow will appear on the screen.

ROOM DATA

Dimensions (feet): Width:[30] Length:[50] Height:[9]
Reflectances: Ceiling:[.9] Walls: [.5] Floor: [.2]

The width (E-W direction) of the space analyzed here is thirty feet, the length (N-S direction) is fifty feet and the height is nine feet.

The surface reflectances of the ceiling, walls, and floor in this example are .9, .5 and .2 respectively.

WINDOW DATA:

Number of Windows (1-10): [2]

This value defines how many windows will be used in the daylighting analysis. For each window, a window description line will be displayed on the worksheet (in this case, two).

Window	Wall (N,E,S,W)	Distances to Sides Left	Right	Heights to Top	Bottom	Trans.	Reflec.
1	[S]	[10]	[20]	[8]	[3]	[.6]	[.1]
2	[W]	[10]	[40]	[8]	[3]	[.6]	[.1]

The wall designator (N,E,S,W) indicates the wall you would see if you were in the room facing that particular direction. The distances to the left and right sides of each window are the orthogonal distances from the lower left corner of each wall as viewed from the inside. (see Figure 4.3). The heights to the top and bottom of the window are measured from the floor. The window's transmittance and reflectance are as measured from the inside.

SKY CONDITION, TIME, LOCATION, AND SITE DATA:

Sky Type (X): Overcast:[X] Clear:[ ] Uniform:[ ]

This line is used to indicate the condition of the sky at the time the calculations are performed. One of these cells must have an 'X' in it, but no more than one cell. If QUICKLITE is being used to supply data to CONTROLITE, then information on this line is ignored.

Time: Daylight Savings Time (X): [X]

An 'X' in the Daylight Savings Time cell here indicates that Daylight Savings Time is in effect at the site.

Month (1-12):[1] Day (1-31):[21] Time (hr.min):[9.45]

Calculation date is indicated on this line. The number of the month is specified, followed by the number of the day in that month and the time of day (see conventions, section 4.3.1 for time specifications). If QUICKLITE is being used to supply data to CONTROLITE, then information on this line is ignored.

Location: Longitude of Site (degrees): [127]
Latitude of Site (degrees): [30]
Time Zone (1-10): [8]

The longitude of the site is the angular distance of the site from Greenwich, England, measured positive in the Westerly direction.

The site's latitude is the angular distance from the Equator to the site. Latitudes in the Northern Hemisphere are positive, Southern Hemisphere latitudes are negative.

The time zone is the number of time zones west of Greenwich, England. The Eastern time zone, for example, is the fifth time zone from Greenwich.

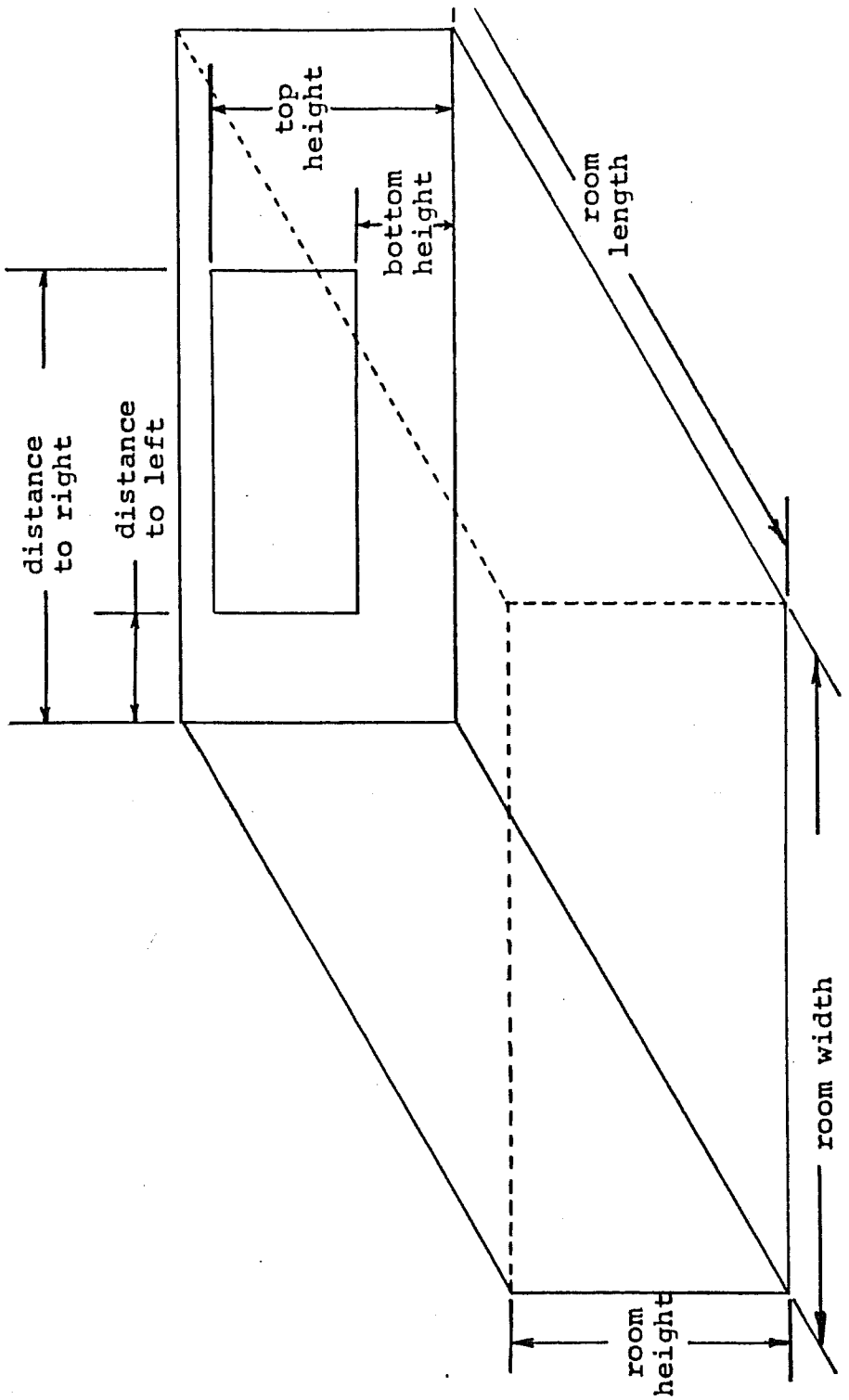


Figure 4.3
Room and window dimensions.

Site: Azimuth of Room (degrees): [0]
Ground Reflectance: [.2]

Room Azimuth is used to specify how the room (or building) is rotated on the site. Room Azimuth is zero when windows on the north wall are facing north. The azimuth angle is equivalent to a clockwise rotation of the room as seen from above, and must be positive .

Ground Reflectance is the reflectance of the ground outside the building (in the area near the windows).

Explicit Solar Information (X) [X]

An 'X' is placed in this cell to indicate wheather the user wishes to input solar information directly, instead of letting QUICKLITE calculate it. This may be the case if other calculations have been performed or if direct measurements have been made at the site. If this cell is X'd, then the following three input lines will appear on the worksheet:

Sun Position (degrees): Altitude: [24] Azimuth: [30]
Illuminance (fc): Direct Sun:[1002]
Overcast Sky:[200] Clear Sky: [101] Uniform Sky:[204]

The sun's position is it's angular position with respect to the site; it's altitude above the horizon, and it's azimuth with respect to due south.

Illuminances are those (in footcandles) which are determined by some means other than QUICKLITE under the specified conditions.

ANALYSIS ARRAY DATA:

Work Plane Height:[2]
Number of Columns:[2] Col. #1:[2.5] Spacing:[5]
Number of Rows :[3] Row #1:[5] Spacing:[5]

The lines above refer to the analysis points at which illuminances are calculated by QUICKLITE. All linear dimensions in feet.

The working plane height is the height above the floor at which illuminances are calculated.

Analysis points are defined at the intersection of columns and rows of the analysis grid. This grid is specified by the number of columns and rows that make up the grid (a maximum of ten rows and ten columns are allowed), the spacing between these columns and rows, and the location of the first column and first row of points in the grid (see Figure 4.4).

Note that, when specifying the analysis grid, care should be taken to be sure that all points on the grid lie within the room.

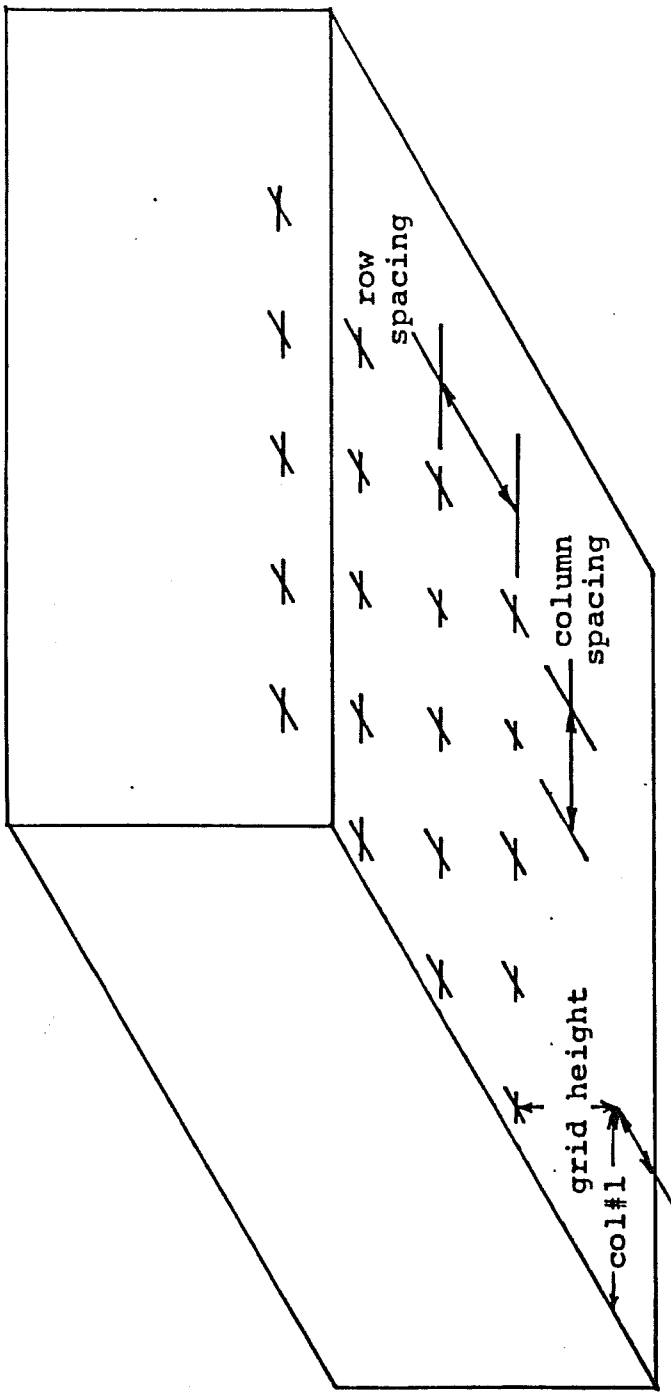


Figure 4.4
Defing the analysis grid.

----------CONTROLITE----------

CONTROLITE ENERGY ANALYSIS (X): [X]

The 'CONTROLITE' line signifies that all further worksheet information pertains to the CONTROLITE control systems analysis.

Placing an 'X' in the CONTROLITE ENERGY ANALYSIS cell indicates that the user wishes to perform a CONTROLITE analysis. If this cell is not X'd, none of the CONTROLITE input worksheet will be displayed.

CONTROL SYSTEM SCHEDULE:

This title block indicates that the items which follow in the worksheet will be used to describe the operation of the control system:

Number of Days per Week (1-7) [7]
Number of Different Daily Control Schemes (1-7): [2]

The number of days per week are the number of days per week that the control system is operational. This number must range from one to seven.

The number of different daily control schemes is the number of days per week that the control system behaves differently from any other day of that week. For example, one control scheme might be used on the weekdays, and another used on weekends.

For each daily control scheme, the following block of control scheme information will be displayed on the worksheet (in our case there are two).

Control Scheme #1:
Number of Days per Week (1-7): [5]
Operation Hours: Start (1-24):[6] Stop (1-24):[20]
Overall Criterion Illuminance (fc): [70]
Number of Time Blocks With a Specific Illuminance (0-5): [3]

Block	Start Time	Stop Time	Illuminance
1	[6.00]	[7.30]	[30]
2	[7.30]	[17.30]	[70]
3	[17.30]	[20]	[25]

Overall Cost/Kilowatt-Hour (dollars): [.045]
Number of Time Blocks With Different Cost/KWH (0-3) [1]

Block	Start Time	Stop Time	Dollars/KWH
1	[6.00]	[7.00]	[.035]

For the first control scheme (Control Scheme #1) the cells above are completed. The second control scheme follows.

The number of days per week are the days per week that this particular scheme is operational (in this case five weekdays).

The operating hours are the starting and ending times for the entire lighting system. For this example, the building lighting turns on at 6AM and finally shuts down at 8PM.

The overall criterion illuminance is the illuminance provided when the control system is fully energized. This value cannot exceed the maximum illuminance that the control system can provide.

The number of time blocks with a specific illuminance is the number of time periods where the illuminance is different from its predecessor. In this example, for this control scheme, there are three time blocks; from 6 to 7:30 AM the illuminance is set at 30fc, from 7:30 AM to 5:30 PM (17.30) the illuminance is 70fc and from 5:30 to 8:00 PM the illuminance is 25fc. A histogram of this control scheme is shown in Figure 4.5a. Note that an input line is displayed on the worksheet for each time block defined above.

To account for changes in electric rates during the day, the next portion of the worksheet allows for adjusting the cost per KWH during up to three time blocks per control scheme. The number of input lines (one for each block) is determined by the number of blocks defined above.

Control Scheme #2:
Number of Days per Week (1-7): [2]
Operation Hours: Start (1-24):[6.00] Stop (1-24):[20.00]
Overall Criterion Illuminance (fc): [70]
Number of Time Blocks With a Specific Illuminance (1-5): [1]

Block	Start Time	Stop Time	Illuminance
1	[6.00]	[20.00]	[30]

Overall Cost/Kilowatt-Hour (dollars): [.045]
Number of Time Blocks with Different Cost/KWH (0-3): [1]

Block	Start Time	Stop Time	Dollars/KWH
1	[1.00]	[7.00]	[.035]

The second control scheme (#2) operates two days per week (the weekend), and provides an illuminance of 30fc from 6 AM to 8PM all weekend. See Figure 4.5b for a histogram of the weekend control scheme.

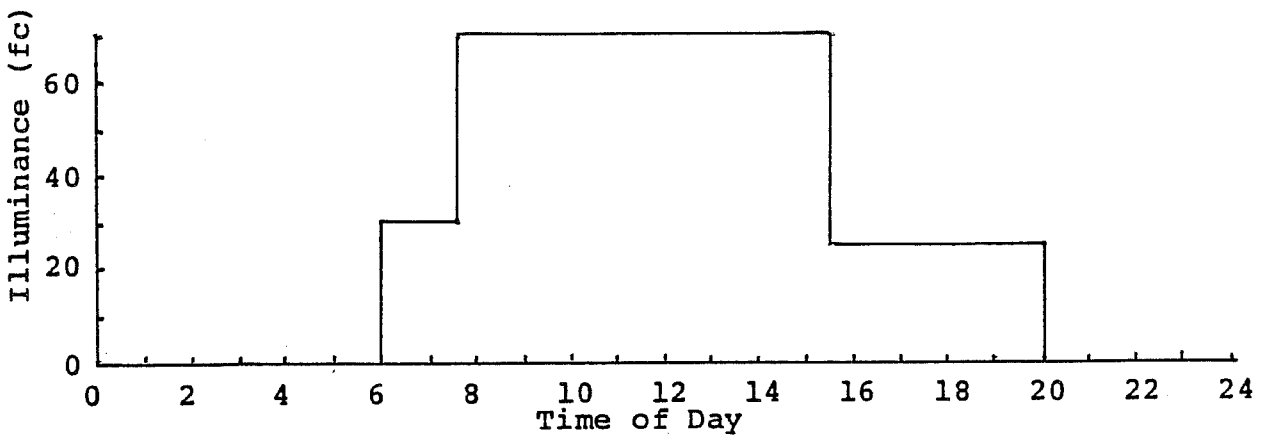


Figure 4.5a.
Lighting control scheme for weekdays.

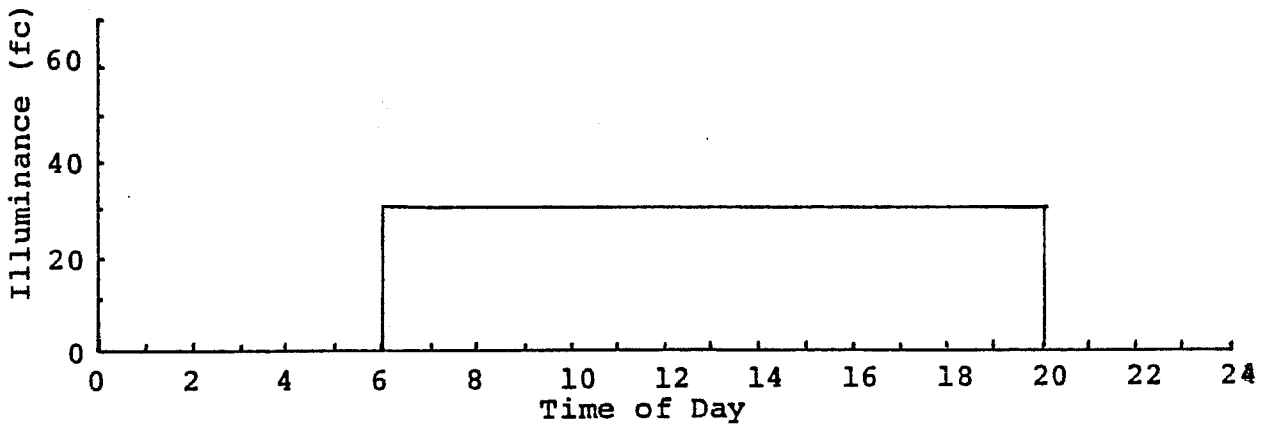


Figure 4.5b.
Lighting control scheme for weekends.

CONTROL SYSTEM POWER INPUT vs. LIGHT OUTPUT DATA:

Affected Area (square feet): [1000]
Control Type (X): Stepped:[X] Continuous-Nonlinear:[ ] Continuous-Linear:[ ]

This section describes the power/light relationship of the control system.

The affected area is the total square footage that is influenced by the control system.

The control type (indicated by placing an 'X' in one cell only) indicates whether the control system is stepped or continuous, linear or nonlinear. A stepped control system is one whose illuminance levels vary in discrete steps, such as when a multi-lamp switching system is used (Figure 4.6a). A continuous system is one whose illuminance levels vary smoothly, as with a well designed dimming system.

Continuous dimming systems may have power input vs. light output relationship which may be linear or non linear. When plotted on a linear scale, if the power/light plot is a straight line, the relationship is linear, as in Figure 4.6b. If the plot is not a straight line (Figure 4.6c) the relationship is nonlinear.

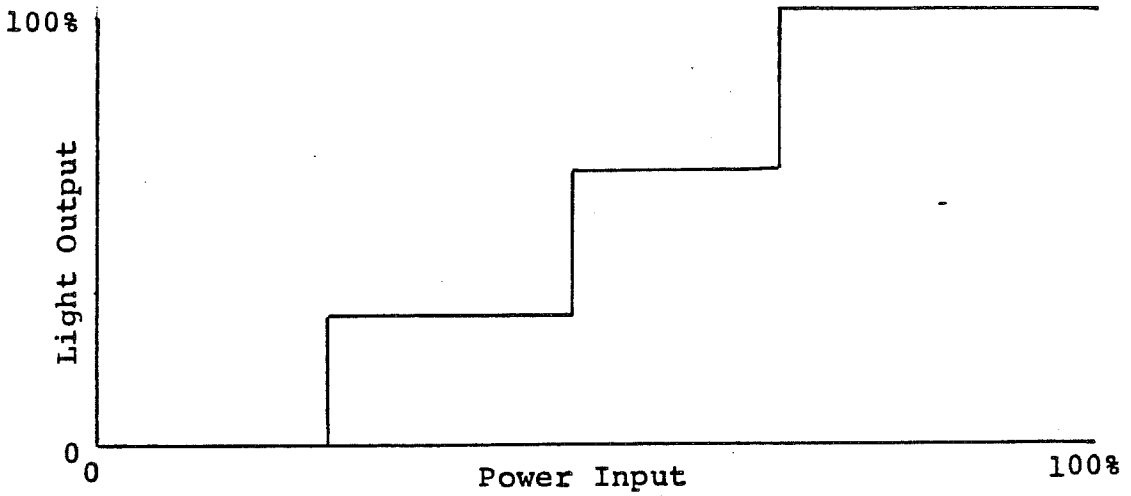
If the power input vs. light output relationship is continuous and linear, only the power and light values at minimum and maximum illuminance are requested on the worksheet.

If the power input vs. light output relationship is stepped or continuous and nonlinear, the following appears on the worksheet:

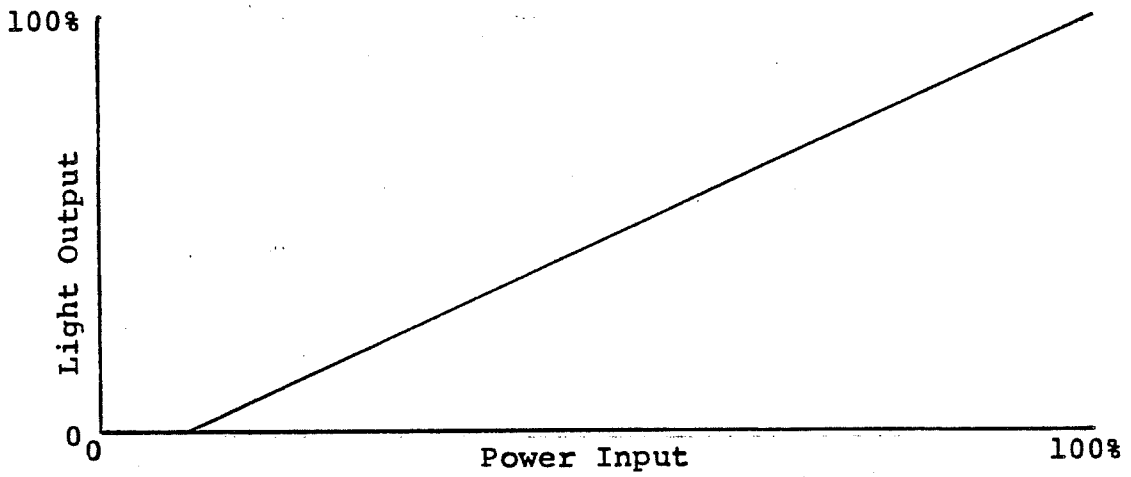
Number of Steps or Ordered Pairs (1-15): [4]

Step or Pair	Decimal Fraction of Power Input	Decimal Fraction of Light Output
1	[0]	[0]
2	[.37]	[.37]
3	[.63]	[.67]
4	[1.00]	[1.00]

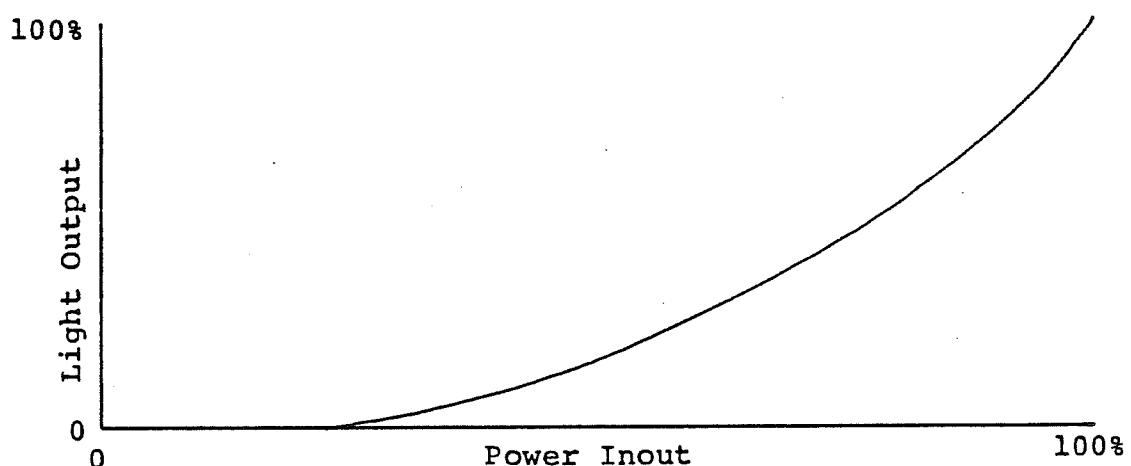
This is a control system operating three lamp luminaires, each with a one and a two lamp switched ballast. This system allows four steps of 0, one third, two thirds and full illuminance, with corresponding fractions of input power.



Power Input
Figure 4.6a
Stepped Control



Power Input
Figure 4.6b
Linear Control



Power Inout
Figure 4.6c
Nonlinear Control

Figure 4.6 Light Output vs. Power Input

DAYLIGHTING ILLUMINANCE DATA:

Daylight Analysis (X): [X]

The following portion of the input worksheet pertains to control systems which respond to daylight. If analysis is required of a daylight control system, then an 'X' is placed in the daylight analysis cell. This will cause the following input lines to be displayed on the worksheet. If the cell is not X'd, the following lines will not appear. If QUICKLITE is invoked the above input line will not be shown.

If QUICKLITE is invoked in this run to perform the necessary daylighting calculations, then input lines pertaining to daylight savings time, the latitude and longitude of the site and the time zone have been answered in the QUICKLIGHT section of the worksheet. If QUICKLITE has not been invoked, then the daylight savings time, longitude, latitude, and time zone input lines are presented here, formatted as in QUICKLITE above.

Decimal Fraction of Clear Sky Per Month:

January: [.40]	February: [.35]	March: [.40]
April: [.40]	May: [.53]	June: [.55]
July: [.60]	August: [.60]	September: [.54]
October: [.50]	November: [.52]	December: [.43]

The above input lines are used to indicate what fraction of each month the sky is clear.

If QUICKLITE has been invoked, CONTROLITE will use it to obtain daylight illuminance values necessary to predict the performance of a daylight-responding lighting control system. If QUICKLITE has not been invoked, CONTROLITE must get its daylight illuminance values from an external source; either calculations from some other program or direct site measurements. If this is the case, CONTROLITE will at this point, place the following input lines on the worksheet for each of seven months (December through June) and for clear and cloudy sky conditions:

Clear Sky Conditions:

Input Illuminance Values at Respective Times, for December 21:

Time:	9.04	10.45	12.25	14.06	15.47
Ill.:	[45]	[78]	[110]	[105]	[89]

Where the illuminance determined in the room where the control system is to be installed is entered at each of the respective times of day, on the date specified.

These lines would be repeated for January 21, February 21, March 21, April 21, May 21 and June 21 for clear skies, then all would be repeated again for cloudy skies.

Because we have invoked QUICKLITE in our example, the above lines are not displayed, and are discussed here only for clarification.

Window Activity Schedule (X): [X]

The line above is displayed on the worksheet only if QUICKLITE analysis is being used. Placing an 'X' in the Window Activity Schedule cell will cause a series of schedules to be added to the worksheet that describe which windows are active (have open shades) and which windows are inactive (have closed shades) under clear and cloudy conditions at various times of day on various days of the year.

The schedule for December 21 looks like this:

Day	Time of Day	Sky Condition	Window # ([X] = Window is deactivated.) 1	2	3	4	5	6	7	8	9	10
Dec 21	9.04	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	10.45	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	12.25	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	14.06	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	15.47	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Cells are X'dto indicate that a particular window is closed off to daylight at that time and day. The Window Activity Schedule always displays ten windows, even if fewer than ten are defined in the QUICKLITE portion of the worksheet. X's placed in undefined windows are ignored. We will not deactivate any windows for our example.

This scheduleis repeated for January 21, February 21, March 21, April 21, May 21, and June 21.

ELECTRIC LIGHTING ILLUMINANCE DATA:

This line signifies that the following portion of the worksheet pertains to the electric lighting system that is being controlled by the system. This portion is used to describe parameters of the lighting systems characteristics and performance.

Maximum Conditions: Illuminance (fc) :[75]
Power (watts/sq.ft):[2.5]

Illuminance is the maximum available illuminance from the controlled lighting system; the maximum average illuminance that the lighting system can deliver when the system is new and the controls are turned on for all luminaires in that system.

The Power is the power density in terms of watts per square foot that the system consumes when fully energized.

Lamp and Luminaire Maintenance, and Light Output Depreciation:

Years:	1	2	3	4	5
Maintained (X):	[ ]	[X]	[ ]	[X]	[ ]

As the maintenence of a lighting system can affect the performance of the control system, it is necessary to describe (if it is known) how that system will be maintained. In this example, we have indicated that the system will be maintained in the second and fourth year; a two year cleaning cycle.

Decimal Fraction of Full Light Output:

Years:	1	2	3	4	5
Before Maintenance:	[.94]	[.82]	[.86]	[.79]	[.82]
After Maintenance:	[ ]	[.90]	[ ]	[.87]	[ ]

In order to account for the resulting energy and cost increases incurred by the lighting system, year-end maintenance factors can be input for a five-year period. Linear interpolation between year end values gibes the appropriate maintenance factor to be applied throughout the course of a year. If cleaning and/or relamping occur before the end of the five year period, an "After Maintenence" factor can be input which will be used to interpolate the respective values for the following year (see Figure 4.7). If there are no years of maintenance indicated, then the "After Maintenence" line will not appear in the worksheet.

ECONOMIC DATA:

This line indicates that the portion of the worksheet which follows pertains to economic information that is required for the CONTROLITE analysis.

Control System Costs (dollars/square foot):

Design:	[.23]
Equipment:	[1.32]
Installation:	[1.74]
Annual Maintenance:	[.002]

The input cells are used to report the costs of the control system and any alterations to the lighting system that are required by the control system. The costs are on a dollars per square foot basis. They include the costs of designing, equipping, and installing the control system as well as the annual cost of maintaining it.

Economic Parameters:

Salvage Value (dollars):	[250.0]
Economic Life (years):	[20]
Interest Rate (decimal):	[.125]

The salvage value is the worth of the control system after it has been used over its economic life. The economic life is how many years the

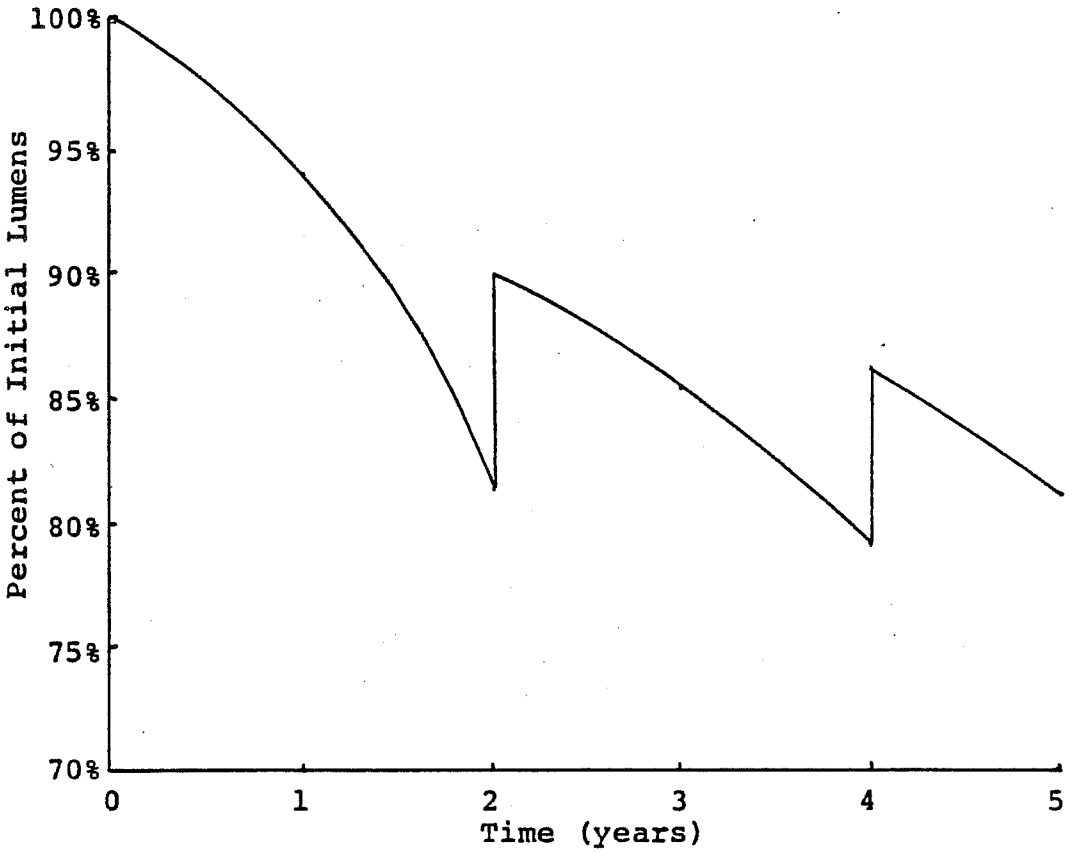


Figure 4.7
Lumen Maintenance Curve.

system is expected to be in use. The interest rate is the rate at which money must be borrowed to impliment the control system. The interest rate must be expressed as a decimal fraction, not as a percentage.

----------OUTPUT INFORMATION----------

The following (and final) portion of the worksheet is used to describe the title page of the output report and how the output is to be presented.

Number of Heading Lines (1-20) [5]

This input cell is used to indicate how many lines are to be in the main heading which will appear in the output report (up to 20 lines are permitted). For each heading line specified in the above cell, a blank heading line (like # 4 below) will be displayed on the worksheet.

```
# 1 [CONTROLITE DOCUMENTATION                                    ]
# 2 [Chapter 4                                                   ]
# 3 [Example Problem                                             ]
# 4 [                                                            ]
# 5 [Blank lines are permitted.                                  ]
```

Each line of the heading may have upto 65 characters. Blank heading lines are permitte. All lines will be centered on the output title page by CONTROLITE.

```
Output Direction (X): Printer:[ ]          File:[X]
                                    File Name:[Example ].LCO
```

CONTROLITE output may be directed toeither the printer or a disk file. This is indicated by typing an 'X' in the appropriate cell in the Output Direction line. If output will be directed to a file, the second line above will appear on the worksheet. A legal DOS filename must then be entered to this cell, to which CONTROLITE will append a filename extension of '.LCO' to identify it as a CONTROLITE output file.

The CONTROLITE input worksheet is now complete. To save the results and return to the menu, type Alt-S, then select menu item 8 to run the program. The output from this example may be found in Appendix A of this manual. Compare it to your output to be sure that you have run CONTROLITE properly.

The following section will discuss how to submit an input file for error checking before running a CONTROLITE analysis. It also discusses the sequence of events that take place when you run the analysis programs using Activity Menu number 8 - 'Run CONTROLITE'.

4.5 Data Checking and Analysis

Once you have successfully completed data input for your analysis and have saved your input file to a diskette, you may submit that file for data checking and analysis. The data checking for CONTROLITE is very thorough and flexible. Error messages can be saved to a file in addition to being displayed on the screen, or may be suppressed altogether for faster checking.

To begin, select Activity 8, 'Run CONTROLITE' . The screen will display:

```
                Enter Selection Number [8]

        Input File Name  -    [EXAMPLE ].LCI
        Error File Name       [ERROR   ].ERR
```

Input the name of the data input file to be checked and an error file name where messages will be written, if desired. If you do not want error messages written to a file, leave the error file name cell blank.

Note: The error files are written to the Data Input Diskette in drive A. Since space on this diskette is limited, it is recommended that the same file name always be used for the error file to avoid a "disk full error". If different error file names are used, you should periodically erase old error files which are no longer needed.

After supplying the appropriate file names, the screen will display:

```
A>COPY B:EXAMPLE.LCI   INPUT.LCI
       1 File(s) copied

A>STARTCQ   ERROR.ERR    INPUT.LCI

Echo all input lines (Y/N)?N
```

Enter a 'Y' if you want every line of your data input file to be displayed on the screen. If you enter 'N', a minimum number of input lines will still be displayed. These lines will aid you in locating and correcting input errors in the file.

Print all error messages (Y/N)?Y

Enter a 'Y' if you want all error messages to appear on the screen and to be written to the error file, if one has been specified. Each message will appear in high intensity letters, and a series of carets '^^^' will point to the cell which generated the error message. In addition, a low frequency double tone will be issued for each error to give you audible feedback. If you respond with 'N', no error message will be displayed, but the carets and the tone will still be issued. After responding to these questions, data checking will begin.

The CONTROLITE data input file diskette which is in Drive B is also used to store all scratch files used for the CONTROLITE analysis. The program output file will also be written to this diskette.

If there are any errors in the input file, the program will report the total number of errors and will return you to the Activity Menu so that the needed modifications can be made to the input file . If there are no errors in the file, the following question will appear on the screen:

Do you wish to continue and run CONTROLITE (Y/N)?Y

If you respond with 'Y', the screen will display a series of commands and prompts which will be discussed in the next section. If you respond with 'N', you will be returned to the beginning of the program for further processing.

4.5.1 Data Analysis

If you have checked the data input file and no errors have been found, and you wish to run the analysis program, you will then need to insert the program diskette that perform the calculations and output into drive A. A message will appear on the screen which will instruct you when to insert the diskette.

Shown below is a list of what should appear on the screen for the problem specified in the Example.

```
                Checking completed - SCRATCH files on B:

A>COPY CHANGE.EXE B:
        1 File(s) copied

A>B:EXECUTE

A>PAUSE  . . . Insert CONTROLITE Calculation Diskette into Drive A:
Strike a key when ready . . .

A>CONLITE B:EXAMPLE.LCO
```

<CONLITE COMPLETE>

A>REM - CONTROLITE is Finished.

4.6 Output and Printing

The previous sections have discussed how to produce a CONTROLITE output report by running the analysis and output program immediately following the data checking session. There may be occasions when you want to input and check data for a particular system but wish to delay the analysis and output activities until later. You would do this by responding with 'N' and the [Enter] key to the question:

Do you wish to continue and run CONTROLITE (Y/N)?N

When you wish to run the analysis programs using the file which has been checked, choose Activity Menu number 8 and repeat the process as just discussed.

If you have requested that your output be written to a file, you can produce an additional paginated output report at any time by typing 'COPY OUTFILE.LCO LPT1', where OUTFILE is the name of the file which you had supplied previously. (The diskette which contains this file should be in the default drive when this command is issued.) This feature permits you to make additional hard copies of the output report without re-running the analysis programs. The scratch files which were used to initially generate this report do not have to be saved to utilize this feature.

IMPORTANT If you request output reports to be written to files, these files will be created and saved on your scratch diskette. You should periodically erase old output files which are no longer needed from your scratch diskette so that there is sufficient room to store the necessary scratch files that are generated when CONTROLITE is executed.

Appendix A: Example Problems

A.0 Introduction

Seven examples are provided to highlight many of the major features of CONTROLITE input and output discussed in preceeding chapters. Each example contains a description of the situation being analyzed, a copy of the input file created from the blank worksheet, and a copy of the resulting output file. The examples range in complexity from very simple to moderately complex.

A.1 Example

This example is that which was used to build the input file in Chapter 4 . The example shows CONTROLITE in a typical run where both the CONTROLITE and QUICKLITE worksheet information are filled in.

```
----------------------------------QUICKLITE----------------------------------

QUICKLITE DAYLIGHTING ANALYSIS  (X):    [X]


ROOM DATA:
----------
Dimensions (feet):  Width:[30   ]      Length:[50   ]      Height:[9    ]
Reflectances:     Ceiling:[.9   ]      Walls: [.5   ]      Floor: [.2   ]


WINDOW DATA:
------------
Number of Windows (1-10):           [2 ]

                      Distances          Heights
            Wall      to Sides             to
Window  (N,E,S,W)    Left    Right     Top     Bottom      Trans.   Reflec.
  1        [S]      [10   ] [20   ]   [8    ] [3    ]     [.6   ]  [.1   ]
  2        [W]      [10   ] [40   ]   [8    ] [3    ]     [.6   ]  [.1   ]


SKY CONDITION, TIME, LOCATION, AND SITE DATA:
---------------------------------------------

Sky Type (X):    Overcast:[X]          Clear:[ ]        Uniform:[ ]
Time:        Daylight Savings Time (X):       [X]
             Month (1-12):[1 ]    Day (1-31):[21]  Time (hr.min):[9.45 ]
Location:    Longitude of Site (degrees):     [127  ]
             Latitude of Site (degrees):      [30   ]
             Time Zone (4-8):                 [8]
Site:        Azimuth of Room (degrees):       [0    ]
             Ground Reflectance:              [.2   ]

Explicit Solar Information (X):         [X]

Sun Position (degrees):           Altitude:  [24   ] Azimuth:    [30   ]
Illuminance (fc):                 Direct Sun:[1002 ]
             Overcast Sky:[200  ] Clear Sky: [101  ] Uniform Sky:[204  ]


ANALYSIS ARRAY DATA:
--------------------
                          Work Plane Height:[2    ]
        Number of Columns:[2    ]     Col. #1:[2.5  ]     Spacing:[5    ]
        Number of Rows   :[3    ]     Row  #1:[5    ]     Spacing:[5    ]


----------------------------------CONTROLITE---------------------------------

CONTROLITE ENERGY ANALYSIS (X):         [X]
```

CONTROL SYSTEM SCHEDULE:

Number of Days per Week (1-7): [7]
Number of Different Daily Control Schemes (1-7): [2]

Control Scheme #1:
Number of Days per Week (1-7): [5]
Operation Hours: Start (1-24):[6] Stop (1-24):[20]
Overall Criterion Illuminance (fc): [70]
Number of Time Blocks With a Specific Illuminance (0-5): [3]

Block	Start Time	Stop Time	Illuminance
1	[6.00]	[7.30]	[30]
2	[7.30]	[17.30]	[70]
3	[17.30]	[20]	[25]

Overall Cost/Kilowatt-Hour (dollars): [.045]
Number of Time Blocks with Different Cost/KWH (0-3): [1]

Block	Start Time	Stop Time	Dollars/KWH
1	[6.00]	[7.00]	[.035]

Control Scheme #2:
Number of Days per Week (1-7): [2]
Operation Hours: Start (1-24):[6.00] Stop (1-24):[20.00]
Overall Criterion Illuminance (fc): [70]
Number of Time Blocks With a Specific Illuminance (0-5): [1]

Block	Start Time	Stop Time	Illuminance
1	[6.00]	[20.00]	[30]

Overall Cost/Kilowatt-Hour (dollars): [.045]
Number of Time Blocks with Different Cost/KWH (0-3): [1]

Block	Start Time	Stop Time	Dollars/KWH
1	[6.00]	[7.00]	[.035]

CONTROL SYSTEM POWER INPUT vs. LIGHT OUTPUT DATA:

Affected Area (square feet): [1000]
Control Type (X): Stepped:[x] Continuous-Nonlinear:[ ] Continuous-Linear:[ ]

Number Of Steps or Ordered Pairs (2-15): [4]

Step or Pair	Decimal Fraction of Power Input	Decimal Fraction of Light Output
1	[0]	[0]
2	[.37]	[.37]

3	[.63]	[.67]
4	[1.00]	[1.00]

DAYLIGHTING ILLUMINANCE DATA:

Decimal Fraction of Clear Sky Per Month:

January:[.40]	February:[.35]	March:[.40]
April:[.40]	May:[.53]	June:[.55]
July:[.60]	August:[.60]	September:[.54]
October:[.50]	November:[.52]	December:[.43]

Window Activity Schedule (X): [X]

Day	Time of Day	Sky Conditon	Window # ([X] - Window is deactivated.) 1	2	3	4	5	6	7	8	9	10
Dec 21	9.04	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	10.45	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	12.25	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	14.06	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	15.47	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Jan 21	9.11	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	10.55	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	12.39	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	14.22	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	16.06	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Feb 21	8.59	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	10.50	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	12.41	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	14.32	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	16.24	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Mar 21	8.36	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	10.35	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	12.35	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	14.35	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	16.34	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Apr 21	8.08	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	10.17	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	12.26	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	14.35	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	16.44	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
May 21	8.52	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	11.08	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	13.24	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	15.40	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	17.56	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
Jun 21	8.50	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	11.10	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	13.29	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	15.48	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
	18.08	clear	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
		cloudy	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

ELECTRIC LIGHTING ILLUMINANCE DATA:

Maximum Conditions: Illuminance (fc) :[75]
Power (watts/sq.ft):[2.5]

Lamp and Luminaire Maintenance, and Light output Depreciation:

Years:	1	2	3	4	5
Maintained (X):	[ ]	[X]	[ ]	[X]	[ ]

Decimal Fraction of Full Light Output:

```
 Years:                  1         2         3         4         5
       Before Maintenance:[.94  ]  [.82  ]  [.86  ]  [.79  ]  [.82  ]
       After Maintenance: [     ]  [.90  ]  [      ]  [.87  ]  [     ]

ECONOMIC DATA:
--------------

Control System Costs (dollars/square foot):
                      Design:                    [.23  ]
                      Equipment:                 [1.32 ]
                      Installation:              [1.74 ]
              Differential Annual Maintenance:   [.002 ]

Economic Parameters:
                      Salvage Value (dollars):   [250.0]
                      Economic Life (years):     [20   ]
            Interest Rate (decimal fraction):    [.125 ]


--------------------------------OUTPUT INFORMATION--------------------------------

Number of Heading Lines:              [5 ]
  # 1 [CONTROLITE DOCUMENTATION                                              ]
  # 2 [Chapter 4                                                             ]
  # 3 [Example problem                                                       ]
  # 4 [                                                                      ]
  # 5 [Blank lines are permitted                                             ]

Output Directives (X):    Printer:[ ]          File: [X]
                                            Filename: [EXAMPLE ].LCO
```

****
CONTROLITE
****

CONTROLITE DOCUMENTATION
Chapter 4
Example problem

Blank lines are permitted

CONTROLITE 1984 LAWRENCE BERKELEY LABORATORY
ONE CYCLOTRON ROAD, BERKELEY, CA 94720

DATE: 1/10/1985

CONTROL SYSTEM CHARACTERISTICS

STEPPED CONTROL:	POWER(%)	LIGHT(%)
	.0	.0
	37.0	37.0
	63.0	67.0
	100.0	100.0

AREA AFFECTED BY CONTROLS: 1000.00 SQ. FEET

MAXIMUM ARTIFICIAL ILLUMINANCE: 75.0 FOOTCANDLES
MAXIMUM POWER INPUT: 2.5 WATTS/SQ.FT.

MAINTENANCE FACTORS AT YEAR END:	YEAR	MF
	1	.94
	2	.82
	3	.86
	4	.79
	5	.82
MAINTENANCE FACTOR FOLLOWING INTERMEDIATE CLEANING:	2	.90
	4	.87

BUILDING IS IN OPERATION 7 DAYS PER WEEK

FOR CONTROL SCHEME 1

CONTROL SCHEME STARTS AT 6.00 AND STOPS AT 20.00
IN EFFECT 5 DAYS PER WEEK

NET EFFECTIVE CONTROL BLOCKS SPECIFIED

START	STOP	CRITERION FC VALUE	COST/KWH
6.00	7.00	30.0	.0350
7.00	7.30	30.0	.0450
7.30	17.30	70.0	.0450
17.30	20.00	25.0	.0450

FOR CONTROL SCHEME 2

CONTROL SCHEME STARTS AT 6.00 AND STOPS AT 20.00
IN EFFECT 2 DAYS PER WEEK

NET EFFECTIVE CONTROL BLOCKS SPECIFIED

START	STOP	CRITERION FC VALUE	COST/KWH
6.00	7.00	30.0	.0350
7.00	20.00	30.0	.0450

DAYLIGHTING INFORMATION

ROOM DIMENSIONS:

WIDTH	30.0
DEPTH	50.0
HEIGHT	9.0

ROOM REFLECTANCES:

CEILING	.90
FLOOR	.20
WALLS	.50
GROUND	.20

HEIGHT OF CALCULATION PLANE: 2.0

LATITUDE OF SITE: 30.0

LONGITUDE OF SITE: 127.0

TIME ZONES WEST OF GREENWICH: 8

INPUT TIMES AND CALCULATED LIGHTING LEVELS: CLEAR SKY CONDITIONS

MONTH	SOLAR SUNRISE	TIME	FC
DEC 21	7.4	9.1	12.7
		10.8	12.7
		12.4	12.7
		14.1	12.7
		15.8	12.7
JAN 21	7.5	9.2	12.7
		10.9	12.7
		12.7	12.7
		14.4	12.7
		16.1	12.7
FEB 21	7.1	9.0	12.7
		10.8	12.7
		12.7	12.7
		14.5	12.7
		16.4	12.7
MAR 21	6.6	8.6	12.7
		10.6	12.7
		12.6	12.7
		14.6	12.7
		16.6	12.7
APR 21	6.0	8.1	12.7
		10.3	12.7
		12.4	12.7
		14.6	12.7
		16.7	12.7
MAY 21	6.6	8.9	12.7
		11.1	12.7
		13.4	12.7
		15.7	12.7
		17.9	12.7
JUN 21	6.5	8.8	12.7
		11.2	12.7
		13.5	12.7
		15.8	12.7
		18.1	12.7

INPUT TIMES AND CALCULATED LIGHTING LEVELS: CLOUDY SKY CONDITIONS

MONTH	SOLAR SUNRISE	TIME	FC
DEC 21	7.4	9.1	12.4
		10.8	12.4
		12.4	12.4
		14.1	12.4
		15.8	12.4
JAN 21	7.5	9.2	12.4
		10.9	12.4
		12.7	12.4
		14.4	12.4
		16.1	12.4
FEB 21	7.1	9.0	12.4
		10.8	12.4
		12.7	12.4
		14.5	12.4
		16.4	12.4
MAR 21	6.6	8.6	12.4
		10.6	12.4
		12.6	12.4
		14.6	12.4
		16.6	12.4
APR 21	6.0	8.1	12.4
		10.3	12.4
		12.4	12.4
		14.6	12.4
		16.7	12.4
MAY 21	6.6	8.9	12.4
		11.1	12.4
		13.4	12.4
		15.7	12.4
		17.9	12.4
JUN 21	6.5	8.8	12.4
		11.2	12.4
		13.5	12.4
		15.8	12.4
		18.1	12.4

ENERGY AND COST PERFORMANCE COMPARISON

MONTHLY VARIATIONS FOR YEAR 1

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	40.	60.	793.99	291.01	35.24	12.81
FEB	35.	65.	713.41	266.59	31.67	11.73
MAR	40.	60.	782.66	302.34	34.73	13.32
APL	40.	60.	743.60	306.40	33.09	13.41
MAY	53.	47.	770.22	314.78	34.21	13.84
JUN	55.	45.	744.76	305.24	33.05	13.45
JLY	60.	40.	770.93	314.07	34.21	13.84
AUG	60.	40.	767.48	317.52	34.15	13.90
SEP	54.	46.	751.13	298.87	33.37	13.13
OCT	50.	50.	788.22	296.78	34.97	13.08
NOV	52.	48.	766.84	283.16	34.04	12.46
DEC	43.	57.	795.88	289.12	35.32	12.73

TOTAL KWH USED= 9189.12
TOTAL KWH SAVED= 3585.88

MONTHLY VARIATIONS FOR YEAR 2

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	40.	60.	818.78	266.22	36.36	11.69
FEB	35.	65.	727.02	252.98	32.28	11.12
MAR	40.	60.	801.53	283.47	35.58	12.47
APL	40.	60.	760.82	289.18	33.81	12.69
MAY	53.	47.	779.90	305.10	34.62	13.43
JUN	55.	45.	752.35	297.65	33.38	13.12
JLY	60.	40.	778.51	306.49	34.54	13.51
AUG	60.	40.	782.63	302.37	34.78	13.27
SEP	54.	46.	769.30	280.70	34.16	12.34
OCT	50.	50.	805.48	279.52	35.75	12.30
NOV	52.	48.	783.75	266.25	34.80	11.70
DEC	43.	57.	835.22	249.78	37.10	10.95

TOTAL KWH USED= 9395.29
TOTAL KWH SAVED= 3379.71

MONTHLY VARIATIONS FOR YEAR 3

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	40.	60.	830.14	254.86	36.87	11.18
FEB	35.	65.	740.75	239.25	32.89	10.51
MAR	40.	60.	811.52	273.48	36.03	12.02
APL	40.	60.	770.17	279.83	34.23	12.27
MAY	53.	47.	781.33	303.67	34.69	13.36
JUN	55.	45.	752.38	297.62	33.38	13.12
JLY	60.	40.	778.61	306.39	34.55	13.50
AUG	60.	40.	788.75	296.25	35.05	13.00
SEP	54.	46.	779.94	270.06	34.64	11.86
OCT	50.	50.	816.99	268.01	36.27	11.78
NOV	52.	48.	799.38	250.62	35.50	11.00
DEC	43.	57.	835.44	249.56	37.11	10.94

TOTAL KWH USED= 9485.41
TOTAL KWH SAVED= 3289.59

MONTHLY VARIATIONS FOR YEAR 4

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	40.	60.	833.74	251.26	37.03	11.02
FEB	35.	65.	744.51	235.49	33.06	10.34
MAR	40.	60.	816.06	268.94	36.23	11.82
APL	40.	60.	777.97	272.03	34.55	11.95
MAY	53.	47.	786.13	298.87	34.89	13.16
JUN	55.	45.	755.44	294.56	33.52	12.98
JLY	60.	40.	782.03	302.97	34.70	13.35
AUG	60.	40.	796.25	288.75	35.36	12.69
SEP	54.	46.	785.85	264.15	34.90	11.60
OCT	50.	50.	821.08	263.92	36.46	11.59
NOV	52.	48.	803.40	246.60	35.68	10.82
DEC	43.	57.	838.58	246.42	37.25	10.80

TOTAL KWH USED= 9541.06
TOTAL KWH SAVED= 3233.94

MONTHLY VARIATIONS FOR YEAR 5

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	40.	60.	833.18	251.82	37.00	11.05
FEB	35.	65.	743.36	236.64	33.01	10.39
MAR	40.	60.	814.88	270.12	36.18	11.87
APL	40.	60.	775.21	274.79	34.44	12.06
MAY	53.	47.	784.52	300.48	34.82	13.23
JUN	55.	45.	755.36	294.64	33.52	12.98
JLY	60.	40.	781.35	303.65	34.67	13.38
AUG	60.	40.	793.41	291.59	35.24	12.81
SEP	54.	46.	784.08	265.92	34.82	11.68
OCT	50.	50.	819.78	265.22	36.40	11.65
NOV	52.	48.	802.44	247.56	35.64	10.86
DEC	43.	57.	838.50	246.50	37.24	10.81

TOTAL KWH USED= 9526.06
TOTAL KWH SAVED= 3248.94

FIRST COSTS FOR CONTROL SYSTEM

DESIGN COSTS:	230.00
EQUIPMENT COSTS:	1320.00
INSTALLATION COSTS:	1740.00

TOTAL DIFFERENTIAL MAINTENANCE COSTS/YEAR: 2.00

CONTROL SYSTEM SALVAGE VALUE AT END OF LIFE: 250.00

ECONOMIC LIFE OF SYSTEM:	20.00
OVERALL INTEREST RATE:	12.50

ANNUAL ENERGY COSTS

YEAR	BASE SYSTEM	CONTROLLED SYSTEM
1	565.75	408.05
2	565.75	417.16
3	565.75	408.05
4	565.75	417.16
5	565.75	408.05
6	565.75	417.16
7	565.75	408.05
8	565.75	417.16
9	565.75	408.05
10	565.75	417.16
11	565.75	408.05
12	565.75	417.16
13	565.75	408.05
14	565.75	417.16
15	565.75	408.05
16	565.75	417.16
17	565.75	408.05
18	565.75	417.16
19	565.75	408.05
20	565.75	417.16

TOTAL PRESENT WORTH (PW) COSTS AND
SAVINGS INVESTMENT RATIO (SIR) AT VARIOUS DIFFERENTIAL
ENERGY RATE INCREASES:

AT .0 % INCREASE/YEAR:

PW BASE:	4096.80
PW CONTROLLED:	6266.65
SIR	.34

AT 3.0 % INCREASE/YEAR:

PW BASE:	5083.33
PW CONTROLLED:	6986.27
SIR	.42

AT 6.0 % INCREASE/YEAR:

PW BASE:	6420.10
PW CONTROLLED:	7961.45
SIR	.53

AT 9.0 % INCREASE/YEAR:

PW BASE:	8255.05
PW CONTROLLED:	9300.18
SIR	.68

AT 12.0 % INCREASE/YEAR:

PW BASE:	10801.54
PW CONTROLLED:	11158.21
SIR	.89

AT 15.0 % INCREASE/YEAR:

PW BASE:	14366.88
PW CONTROLLED:	13759.90
SIR	1.19

A.2 Example 1

A single story, 12,000 square foot office building has a uniform lighting layout throughout the space producing an overall average of 75 footcandles at 2.4 watts/square foot. There are no individual switches for lights, and all lights are turned on at 7:00 a.m. when the first employee arrives and are left on until 11:00 p.m. after final mainteance work is done. The building will not be used on the weekends.

The power profile for a typical day is shown in Figure EX1.1.

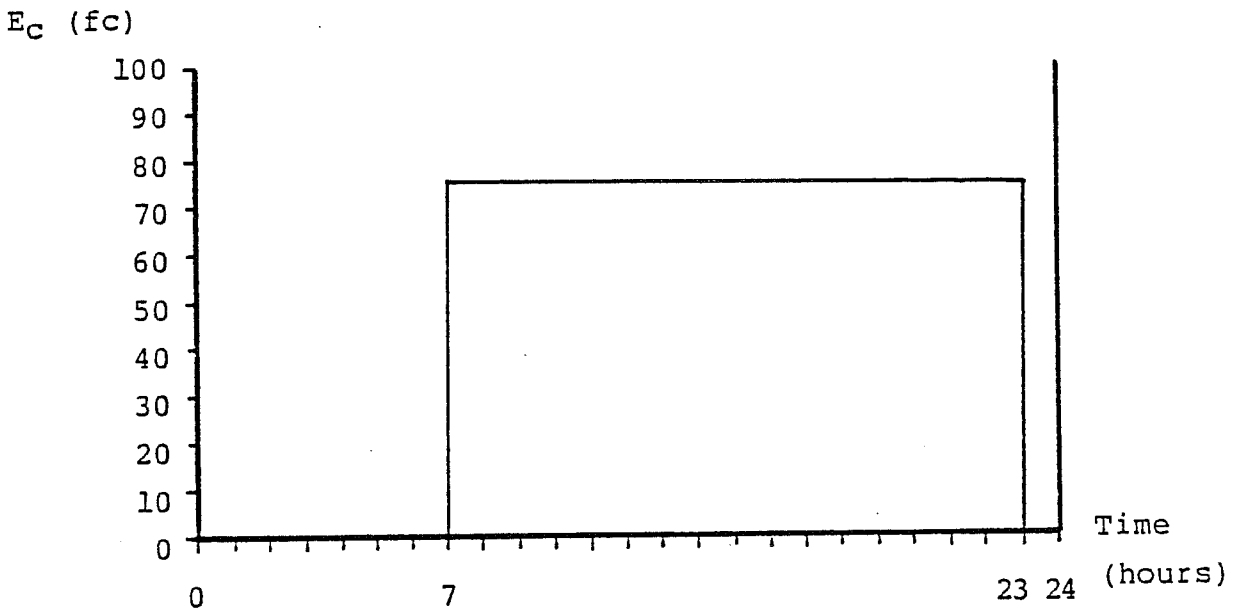


Figure EX1.1 Overall average of 75 footcandles with all lights turned on.

A control scheme utilizing three level switching, controlled by time clocks is proposed which would respond more realistically to building occupancy needs. Since the office tends to be open late on Fridays, two different power profiles are as shown in Figure EX1.2.

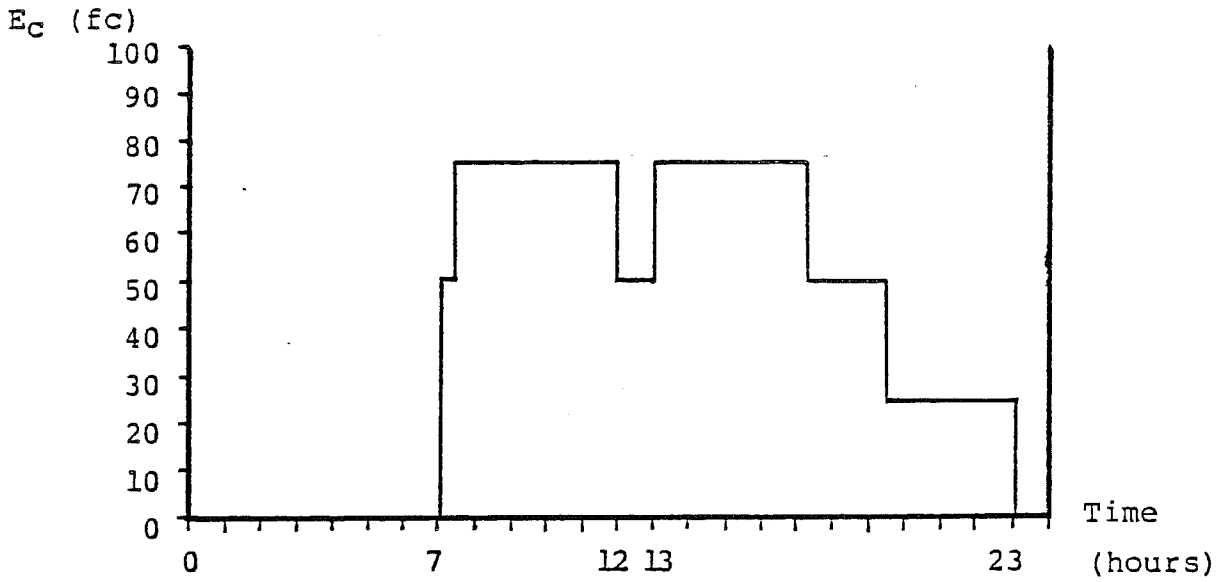


Figure EX1.2a E_c histogram for Monday thru Thursday schedule.

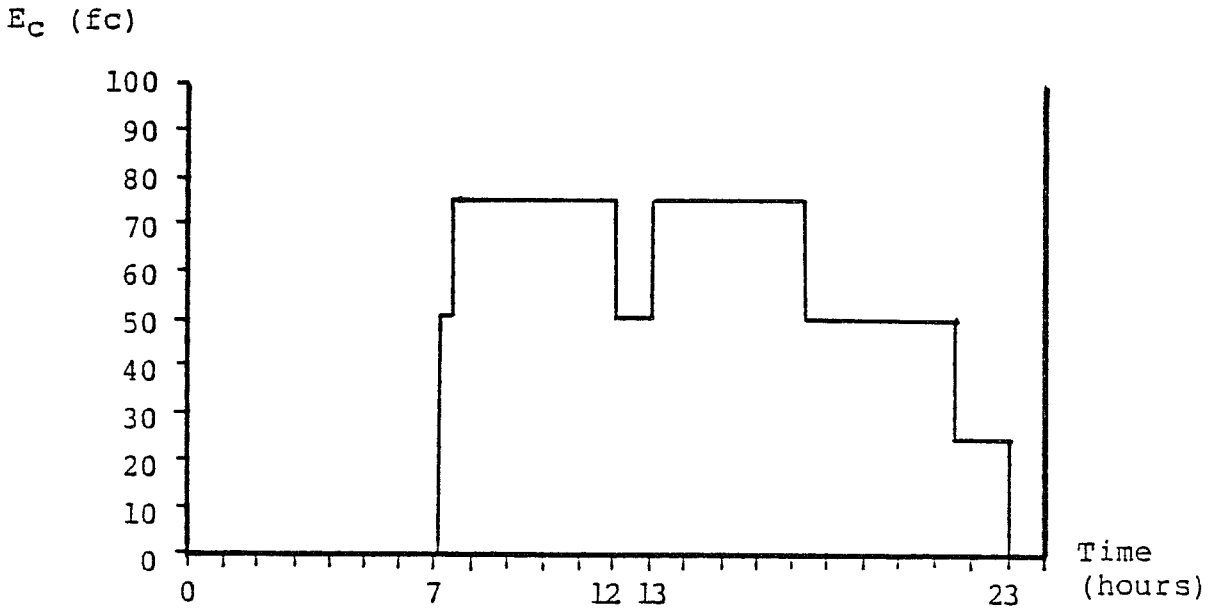


Figure EX1.2b E_c histogram for Friday occupancy schedule.

All luminaires are three lamp 2'x 4' recessed fluorescent troffers, and reductions in overall light levels will come from simply operating these units at one, two or three lamp output. Energy costs are at $.045/KWH, and control system equipment costs are for an installed system, thus no separate installed costs.

----------QUICKLITE----------

QUICKLITE DAYLIGHTING ANALYSIS (X): [ ]

----------CONTROLITE----------

CONTROLITE ENERGY ANALYSIS (X): [X]

CONTROL SYSTEM SCHEDULE:

Number of Days per Week (1-7): [5]
Number of Different Daily Control Schemes (1-7): [2]

Control Scheme #1:
Number of Days per Week (1-7): [4]
Operation Hours: Start (1-24):[7] Stop (1-24):[23]
Overall Criterion Illuminance (fc): [75]
Number of Time Blocks With a Specific Illuminance (1-5): [4]

Block	Start Time	Stop Time	Illuminance
1	[7]	[7.5]	[50]
2	[12]	[13]	[50]
3	[17.5]	[19.5]	[50]
4	[19.5]	[23]	[25]

Overall Cost/Kilowatt-Hour (dollars): [.045]
Number of Time Blocks with Different Cost/KWH (0-3): [0]

Control Scheme #2:
Number of Days per Week (1-7): [1]
Operation Hours: Start (1-24):[7] Stop (1-24):[23]
Overall Criterion Illuminance (fc): [75]
Number of Time Blocks With a Specific Illuminance (1-5): [4]

Block	Start Time	Stop Time	Illuminance
1	[7]	[7.5]	[50]
2	[12]	[13]	[50]
3	[17.5]	[21.5]	[50]
4	[21.5]	[23]	[25]

Overall Cost/Kilowatt-Hour (dollars): [.045]
Number of Time Blocks with Different Cost/KWH (0-3): [0]

CONTROL SYSTEM POWER INPUT vs. LIGHT OUTPUT DATA:

Affected Area (square feet): [12000]

Control Type (X): Stepped:[X] Continuous-Nonlinear:[ ] Continuous-Linear:[ ]

Number Of Steps or Ordered Pairs (1-15): [3]

Step or Pair	Decimal Fraction of Power Input	Decimal Fraction of Light Output
1	[1.]	[1.]
2	[.67]	[.67]
3	[.34]	[.34]

DAYLIGHTING ILLUMINANCE DATA:

Daylight Analysis (X): [ ]

ELECTRIC LIGHTING ILLUMINANCE DATA:

Maximum Conditions: Illuminance (fc) :[75]
Power (watts/sq.ft):[2.4]

ECONOMIC DATA:

Control System Costs (dollars/square foot):
Design: [.025]
Equipment: [.25]
Installation: [.0001]
Differential Annual Maintenance:[0]

Economic Parameters:
Salvage Value (dollars):[0]
Economic Life (years): [10]
Interest Rate (decimal fraction):[.15]

----------OUTPUT INFORMATION----------

Number of Heading Lines: [1]
1 [CONTROLITE DOCUMENTATION EXAMPLE #1]

Output Directives (X): Printer:[ ] File: [X]
Filename: [EXAMPLE1].LCO

****
CONTROLITE
****

CONTROLITE DOCUMENTATION EXAMPLE #1

CONTROLITE 1984 LAWRENCE BERKELEY LABORATORY
ONE CYCLOTRON ROAD, BERKELEY, CA 94720

DATE: 1/ 9/1984

CONTROL SYSTEM CHARACTERISTICS

STEPPED CONTROL:	POWER(%)	LIGHT(%)
	34.0	34.0
	67.0	67.0
	100.0	100.0

AREA AFFECTED BY CONTROLS: 12000.00 SQ. FEET

MAXIMUM ARTIFICIAL ILLUMINANCE: 75.0 FOOTCANDLES
MAXIMUM POWER INPUT: 2.4 WATTS/SQ.FT.

BUILDING IS IN OPERATION 5 DAYS PER WEEK

FOR CONTROL SCHEME 1

CONTROL SCHEME STARTS AT 7.00 AND STOPS AT 23.00
IN EFFECT 4 DAYS PER WEEK

NET EFFECTIVE CONTROL BLOCKS SPECIFIED

START	STOP	CRITERION FC VALUE	COST/KWH
7.00	7.50	50.0	.0450
7.50	12.00	75.0	.0450
12.00	13.00	50.0	.0450
13.00	17.50	75.0	.0450
17.50	19.50	50.0	.0450
19.50	23.00	25.0	.0450

FOR CONTROL SCHEME 2

CONTROL SCHEME STARTS AT 7.00 AND STOPS AT 23.00
IN EFFECT 1 DAYS PER WEEK

NET EFFECTIVE CONTROL BLOCKS SPECIFIED

START	STOP	CRITERION FC VALUE	COST/KWH
7.00	7.50	50.0	.0450
7.50	12.00	75.0	.0450
12.00	13.00	50.0	.0450
13.00	17.50	75.0	.0450
17.50	21.50	50.0	.0450
21.50	23.00	25.0	.0450

ENERGY AND COST PERFORMANCE COMPARISON

FIRST COSTS FOR CONTROL SYSTEM

DESIGN COSTS:	300.00
EQUIPMENT COSTS:	3000.00
INSTALLATION COSTS:	.00

TOTAL DIFFERENTIAL MAINTENANCE COSTS/YEAR: .00

CONTROL SYSTEM SALVAGE VALUE AT END OF LIFE: .00

ECONOMIC LIFE OF SYSTEM:	10.00
OVERALL INTEREST RATE:	15.00

TOTAL KWH USED FOR THE YEAR =	95111.08
TOTAL KWH SAVED FOR THE YEAR =	25026.08
TOTAL COST FOR THE YEAR =	4280.00
TOTAL COST SAVED FOR THE YEAR=	1126.17

ANNUAL ENERGY COSTS

YEAR	BASE SYSTEM	CONTROLLED SYSTEM
1	5406.17	4280.00
2	5406.17	4280.00
3	5406.17	4280.00
4	5406.17	4280.00
5	5406.17	4280.00
6	5406.17	4280.00
7	5406.17	4280.00
8	5406.17	4280.00
9	5406.17	4280.00
10	5406.17	4280.00

TOTAL PRESENT WORTH(PW) COSTS AND
SAVINGS INVESTMENT RATIO (SIR) AT VARIOUS DIFFERENTIAL
ENERGY RATE INCREASES:

AT .0 % INCREASE/YEAR:

PW BASE:	27132.33
PW CONTROLLED:	24780.33
SIR	1.71

AT 3.0 % INCREASE/YEAR:

PW BASE:	30988.11
PW CONTROLLED:	27832.90
SIR	1.96

AT 6.0 % INCREASE/YEAR:

PW BASE:	35486.68
PW CONTROLLED:	31394.37
SIR	2.24

AT 9.0 % INCREASE/YEAR:

PW BASE:	40740.74
PW CONTROLLED:	35553.94
SIR	2.57

AT 12.0 % INCREASE/YEAR:

PW BASE:	46881.54
PW CONTROLLED:	40415.53
SIR	2.96

AT 15.0 % INCREASE/YEAR:

PW BASE:	54061.72
PW CONTROLLED:	46099.99
SIR	3.41

A.3 Example 2

A drafting area in a large commercial facility is to be a test installation for a new type of lighting control system. The system includes a retrofit fluorescent dimmer pack and a ceiling mounted photo cell. The purpose of the system is to maintain constant illumination in the space throughout its life. Initial power input and light output are below maximum values, and increase as lamp lumen depreciation and luminaire dirt depreciation occur. When the criteria illuminance value can no longer be supplied at full light output, cleaning and relamping will be done and the cycle starts over. (see Figure EX.2)

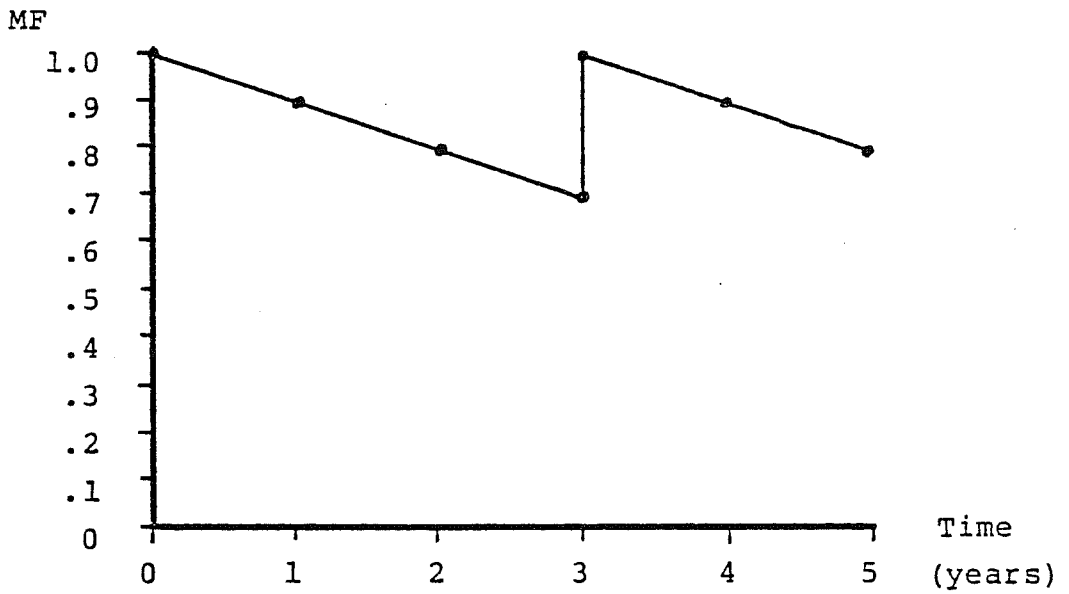


Figure EX.2 Graph of total light loss factor with a three year cleaning cycle.

The area is 1,000 square feet with a constant illuminance criteria of 110 footcandles. A three year cleaning cycle is in effect with depreciation down to 70% light output at the end of three years, thus, 160 footcandles initial must be provided. The watts per square foot loading is 4.2 watts per square foot. The power input vs. light output relationship is linear in the range of concern. No other special controls are planned, and the space is in operation 16 hours per day, 5 days of the week. The energy cost is .055 dollars/KWH.

----------QUICKLITE----------

QUICKLITE DAYLIGHTING ANALYSIS (X): [ ]

----------CONTROLITE----------

CONTROLITE ENERGY ANALYSIS (X): [X]

CONTROL SYSTEM SCHEDULE:

Number of Days per Week (1-7): [5]
Number of Different Daily Control Schemes (1-7): [1]

Control Scheme #1:
Number of Days per Week (1-7): [5]
Operation Hours: Start (1-24):[6] Stop (1-24):[22]
Overall Criterion Illuminance (fc): [110]
Number of Time Blocks With a Specific Illuminance (1-5): [0]

Overall Cost/Kilowatt-Hour (dollars): [.055]
Number of Time Blocks with Different Cost/KWH (0-3): [0]

CONTROL SYSTEM POWER INPUT vs. LIGHT OUTPUT DATA:

Affected Area (square feet): [1000]
Control Type (X): Stepped:[ ] Continuous-Nonlinear:[ ] Continuous-Linear:[X]

Decimal Fraction Power Input: Maximum:[1] Minimum:[.4]
Decimal Fraction Power Output: Maximum:[1] Minimum:[.4]

DAYLIGHTING ILLUMINANCE DATA:

Daylight Analysis (X): [ ]

ELECTRIC LIGHTING ILLUMINANCE DATA:

Maximum Conditions: Illuminance (fc) :[160]
Power (watts/sq.ft):[4.2]
Lamp and Luminaire Maintenance, and Light output Depreciation:

Years:	1	2	3	4	5
Maintained (X):	[ ]	[ ]	[X]	[ ]	[ ]

Decimal Fraction of Full Light Output:

Years:	1	2	3	4	5
Before Maintenance:	[.9]	[.8]	[.7]	[.9]	[.8]

```
      After Maintenance: [      ]  [      ]  [1     ]  [      ]  [      ]

ECONOMIC DATA:
--------------

Control System Costs (dollars/square foot):
                      Design:                    [.0001]
                      Equipment:                 [.83  ]
                      Installation:              [.17  ]
              Differential Annual Maintenance:   [0     ]

Economic Parameters:
                      Salvage Value (dollars):   [0     ]
                      Economic Life (years):     [12    ]
             Interest Rate (decimal fraction):   [.17   ]

--------------------------------OUTPUT INFORMATION-------------------------------

Number of Heading Lines:                [1 ]
  # 1 [CONTROLITE DOCUMENTATION EXAMPLE #2                                    ]

Output Directives (X):    Printer:[ ]          File: [X]
                                             Filename: [EXAMPLE2].LCO
```

****
CONTROLITE
****

CONTROLITE DOCUMENTATION EXAMPLE #2

CONTROLITE 1984 LAWRENCE BERKELEY LABORATORY
ONE CYCLOTRON ROAD, BERKELEY, CA 94720

DATE: 1/ 9/1985

CONTROL SYSTEM CHARACTERISTICS

CONTINUOUS DIMMING
LINEAR RELATIONSHIP:

MAXIMUM POWER(%):	100.0
MINIMUM POWER(%):	40.0
MAXIMUM LIGHT(%):	100.0
MINIMUM LIGHT(%):	40.0

AREA AFFECTED BY CONTROLS: 1000.00 SQ. FEET

MAXIMUM ARTIFICIAL ILLUMINANCE: 160.0 FOOTCANDLES
MAXIMUM POWER INPUT: 4.2 WATTS/SQ.FT.

MAINTENANCE FACTORS
AT YEAR END:

YEAR	MF
1	.90
2	.80
3	.70
4	.90
5	.80

MAINTENANCE FACTOR
FOLLOWING INTERMEDIATE
CLEANING: 3 1.00

BUILDING IS IN OPERATION 5 DAYS PER WEEK

FOR CONTROL SCHEME 1

CONTROL SCHEME STARTS AT 6.00 AND STOPS AT 22.00
IN EFFECT 5 DAYS PER WEEK

NET EFFECTIVE CONTROL BLOCKS SPECIFIED

START	STOP	CRITERION FC VALUE	COST/KWH
6.00	22.00	110.0	.0550

ENERGY AND COST PERFORMANCE COMPARISON

YEAR	KWH USED	KWH SAVED
1	12714.17	4805.83
2	14219.79	3300.21
3	16131.70	1388.30
4	12714.17	4805.83
5	14219.79	3300.21

FIRST COSTS FOR CONTROL SYSTEM

DESIGN COSTS:	.00
EQUIPMENT COSTS:	830.00
INSTALLATION COSTS:	170.00

TOTAL DIFFERENTIAL MAINTENANCE COSTS/YEAR: .00

CONTROL SYSTEM SALVAGE VALUE AT END OF LIFE: .00

ECONOMIC LIFE OF SYSTEM:	12.00
OVERALL INTEREST RATE:	17.00

ANNUAL ENERGY COSTS

YEAR	BASE SYSTEM	CONTROLLED SYSTEM
1	963.60	699.28
2	963.60	782.09
3	963.60	887.24
4	963.60	699.28
5	963.60	782.09
6	963.60	887.24
7	963.60	699.28
8	963.60	782.09
9	963.60	887.24
10	963.60	699.28
11	963.60	782.09
12	963.60	887.24

TOTAL PRESENT WORTH (PW) COSTS AND
SAVINGS INVESTMENT RATIO (SIR) AT VARIOUS DIFFERENTIAL
ENERGY RATE INCREASES:

AT .0 % INCREASE/YEAR:

PW BASE:	4806.81
PW CONTROLLED:	4889.80
SIR	.92

AT 3.0 % INCREASE/YEAR:

PW BASE:	5553.23
PW CONTROLLED:	5504.33
SIR	1.05

AT 6.0 % INCREASE/YEAR:

PW BASE:	6446.05
PW CONTROLLED:	6240.41
SIR	1.21

AT 9.0 % INCREASE/YEAR:

PW BASE:	7517.01
PW CONTROLLED:	7124.61
SIR	1.39

AT 12.0 % INCREASE/YEAR:

PW BASE:	8804.65
PW CONTROLLED:	8189.22
SIR	1.62

AT 15.0 % INCREASE/YEAR:

PW BASE:	10355.59
PW CONTROLLED:	9473.37
SIR	1.88

A.4 Example 3

A fluorescent Equi-Illumination Dimming System which responds to daylight input as well as light loss variations is being considered for the perimeter zone of a large open office area. Criterion illuminance of 60 footcandle on the desk is desired and the total maintenance factor will be 80 footcandles minimum at the end of a three year cleaning cycle; thus 75 initial footcandles must be provided by the artificial lighting system for times when daylight is not available. A total area of 1400 square feet loaded at 1.8 Watt per square foot is to be controlled by the same sensor. The power input vs light output relationship is slightly non-linear, as shown in Figure Ex. 3.1. The lighting system operates from 6:00 a.m. to 6:00 p.m. five days per week. The off-peak energy rate is .048 dollares/kwh and on-peak rate is .064 dollars/kwh between the hours of 9:00 a.m. and 1:00 p.m. Five input values of daylight available in the space are sufficient to describe the variation in daylight throughout the day, for both clear and cloudy conditions. Daylight values, % clear sky and all other input parameters are included below in the listing of the input file.

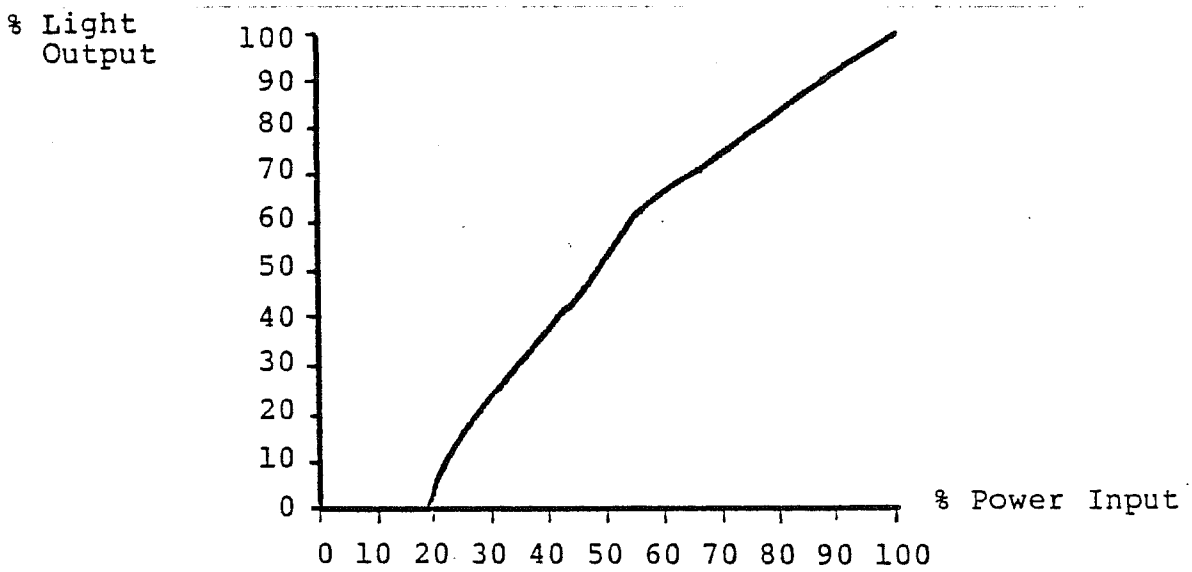


FIG. EX. 3.1. Non-linear relationship for flourescent diming equipment

QUICKLITE

QUICKLITE DAYLIGHTING ANALYSIS (X): [ ]

CONTROLITE

CONTROLITE ENERGY ANALYSIS (X): [X]

CONTROL SYSTEM SCHEDULE:

Number of Days per Week (1-7): [5]
Number of Different Daily Control Schemes (1-7): [1]

Control Scheme #1:
Number of Days per Week (1-7): [5]
Operation Hours: Start (1-24):[6] Stop (1-24):[18]
Overall Criterion Illuminance (fc): [60]
Number of Time Blocks With a Specific Illuminance (1-5): [0]

Overall Cost/Kilowatt-Hour (dollars): [.048]
Number of Time Blocks with Different Cost/KWH (0-3): [1]

Block	Start Time	Stop Time	Dollars/KWH
1	[9]	[13]	[.064]

CONTROL SYSTEM POWER INPUT vs. LIGHT OUTPUT DATA:

Affected Area (square feet): [1400]
Control Type (X): Stepped:[ ] Continuous-Nonlinear:[X] Continuous-Linear:[ ]

Number Of Steps or Ordered Pairs (1-15): [11]

Step or Pair	Decimal Fraction of Power Input	Decimal Fraction of Light Output
1	[.18]	[0]
2	[.23]	[.1]
3	[.28]	[.2]
4	[.35]	[.3]
5	[.42]	[.4]
6	[.47]	[.5]
7	[.54]	[.6]
8	[.66]	[.7]
9	[.77]	[.8]
10	[.88]	[.9]
11	[1]	[1]

DAYLIGHTING ILLUMINANCE DATA:

Daylight Analysis (X): [X]

Daylight Savings Time (X): [ ]

Longitude of Site (degrees): [82]
Latitude of site (degrees): [40]
Time Zone (1-10): [5]
Decimal Fraction of Clear Sky Per Month:

January:[.30]	February:[.30]	March:[.35]
April:[.50]	May:[.55]	June:[.60]
July:[.60]	August:[.55]	September:[.50]
October:[.50]	November:[.45]	December:[.40]

Clear Sky Conditions:

Input Illuminance Values at Respective Times, for December 21:

Time:	9.22	10.54	12.25	13.57	15.28
Ill.:	[45]	[58]	[70]	[80]	[90]

Input Illuminance Values at Respective Times, for January 21:

Time:	9.26	11.02	12.39	14.15	15.51
Ill.:	[50]	[63]	[75]	[85]	[95]

Input Illuminance Values at Respective Times, for February 21:

Time:	9.07	10.54	12.41	14.29	16.16
Ill.:	[55]	[68]	[80]	[90]	[100]

Input Illuminance Values at Respective Times, for March 21:

Time:	8.36	10.35	12.35	14.34	16.34
Ill.:	[60]	[73]	[85]	[95]	[105]

Input Illuminance Values at Respective Times, for April 21:

Time:	8.00	10.13	12.26	14.39	16.52
Ill.:	[65]	[78]	[90]	[100]	[110]

Input Illuminance Values at Respective Times, for May 21:

Time:	7.36	10.00	12.24	14.48	17.11
Ill.:	[70]	[83]	[95]	[105]	[115]

Time:	7.32	10.00	12.29	14.57	17.26
Ill.:	[75]	[88]	[100]	[110]	[120]

Cloudy Sky Conditions:

Input Illuminance Values at Respective Times, for December 21:

Time:	9.22	10.54	12.25	13.57	15.28
Ill.:	[20]	[25]	[30]	[35]	[40]

Input Illuminance Values at Respective Times, for January 21:
Time: 9.26 11.02 12.39 14.15 15.51
Ill.: [22] [27] [32] [37] [42]

Input Illuminance Values at Respective Times, for February 21:
Time: 9.07 10.54 12.41 14.29 16.16
Ill.: [25] [30] [35] [40] [45]

Input Illuminance Values at Respective Times, for March 21:
Time: 8.36 10.35 12.35 14.34 16.34
Ill.: [25] [30] [35] [40] [45]

Input Illuminance Values at Respective Times, for April 21:
Time: 8.00 10.13 12.26 14.39 16.52
Ill.: [30] [35] [40] [45] [45]

Input Illuminance Values at Respective Times, for May 21:
Time: 7.36 10.00 12.24 14.48 17.11
Ill.: [33] [38] [43] [48] [53]

Input Illuminance Values at Respective Times, for June 21:
Time: 7.32 10.00 12.29 14.57 17.26
Ill.: [40] [42] [45] [53] [60]

ELECTRIC LIGHTING ILLUMINANCE DATA:

Maximum Conditions: Illuminance (fc) :[75]
Power (watts/sq.ft):[1.8]
Lamp and Luminaire Maintenance, and Light output Depreciation:

Years:	1	2	3	4	5
Maintained (X):	[ ]	[ ]	[X]	[ ]	[ ]

Decimal Fraction of Full Light Output:

Years:	1	2	3	4	5
Before Maintenance:	[.92]	[.87]	[.8]	[.92]	[.87]
After Maintenance:	[ ]	[ ]	[1.]	[ ]	[ ]

ECONOMIC DATA:

Control System Costs (dollars/square foot):
Design: [.12]
Equipment: [1.05]
Installation: [.3]
Differential Annual Maintenance:[0]

Economic Parameters:
Salvage Value (dollars):[0]
Economic Life (years): [15]
Interest Rate (decimal fraction):[.15]

```
----------------------------------OUTPUT INFORMATION----------------------------------

 Number of Heading Lines:              [1 ]
   # 1 [CONTROLITE DOCUMENTATION EXAMPLE #3                    ]

 Output Directives (X):    Printer:[ ]          File: [X]
                                              Filename: [EXAMPLE3].LCO
```

****
CONTROLITE
****

CONTROLITE DOCUMENTATION EXAMPLE #3

CONTROLITE 1984 LAWRENCE BERKELEY LABORATORY
ONE CYCLOTRON ROAD, BERKELEY, CA 94720

DATE: 1/ 9/1985

CONTROL SYSTEM CHARACTERISTICS

CONTINUOUS DIMMING
NON-LINEAR RELATIONSHIP:

POWER(%)	LIGHT(%)
18.0	.0
23.0	10.0
28.0	20.0
35.0	30.0
42.0	40.0
47.0	50.0
54.0	60.0
66.0	70.0
77.0	80.0
88.0	90.0
100.0	100.0

AREA AFFECTED BY CONTROLS: 1400.00 SQ. FEET

MAXIMUM ARTIFICIAL ILLUMINANCE: 75.0 FOOTCANDLES
MAXIMUM POWER INPUT: 1.8 WATTS/SQ.FT.

MAINTENANCE FACTORS
AT YEAR END:

YEAR	MF
1	.92
2	.87
3	.80
4	.92
5	.87

MAINTENANCE FACTOR
FOLLOWING INTERMEDIATE
CLEANING: 3 1.00

BUILDING IS IN OPERATION 5 DAYS PER WEEK

FOR CONTROL SCHEME 1

CONTROL SCHEME STARTS AT 6.00 AND STOPS AT 18.00
IN EFFECT 5 DAYS PER WEEK

NET EFFECTIVE CONTROL BLOCKS SPECIFIED

START	STOP	CRITERION FC VALUE	COST/KWH
6.00	9.00	60.0	.0480
9.00	13.00	60.0	.0640
13.00	18.00	60.0	.0480

DAYLIGHTING INFORMATION

LONGITUDE OF SITE: 82.0

TIME ZONES WEST OF GREENWICH: 5

INPUT TIMES AND LIGHTING LEVELS: CLEAR SKY CONDITIONS

MONTH	SOLAR SUNRISE	TIME	FC
DEC 21	7.8	9.4	45.0
		10.9	58.0
		12.4	70.0
		14.0	80.0
		15.5	90.0
JAN 21	7.8	9.4	50.0
		11.0	63.0
		12.7	75.0
		14.3	85.0
		15.9	95.0
FEB 21	7.3	9.1	55.0
		10.9	68.0
		12.7	80.0
		14.5	90.0
		16.3	100.0
MAR 21	6.6	8.6	60.0
		10.6	73.0
		12.6	85.0
		14.6	95.0
		16.6	105.0
APR 21	5.8	8.0	65.0
		10.2	78.0
		12.4	90.0
		14.7	100.0
		16.9	110.0
MAY 21	5.2	7.6	70.0
		10.0	83.0
		12.4	95.0
		14.8	105.0
		17.2	115.0
JUN 21	5.1	7.5	75.0
		10.0	88.0
		12.5	100.0
		15.0	110.0
		17.4	120.0

INPUT TIMES AND LIGHTING LEVELS: CLOUDY SKY CONDITIONS

MONTH	SOLAR SUNRISE	TIME	FC
DEC 21	7.8	9.4	20.0
		10.9	25.0
		12.4	30.0
		14.0	35.0
		15.5	40.0
JAN 21	7.8	9.4	22.0
		11.0	27.0
		12.7	32.0
		14.3	37.0
		15.9	42.0
FEB 21	7.3	9.1	25.0
		10.9	30.0
		12.7	35.0
		14.5	40.0
		16.3	45.0
MAR 21	6.6	8.6	25.0
		10.6	30.0
		12.6	35.0
		14.6	40.0
		16.6	45.0
APR 21	5.8	8.0	30.0
		10.2	35.0
		12.4	40.0
		14.7	45.0
		16.9	45.0
MAY 21	5.2	7.6	33.0
		10.0	38.0
		12.4	43.0
		14.8	48.0
		17.2	53.0
JUN 21	5.1	7.5	40.0
		10.0	42.0
		12.5	45.0
		15.0	53.0
		17.4	60.0

ENERGY AND COST PERFORMANCE COMPARISON

MONTHLY VARIATIONS FOR YEAR 1

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	30.	70.	323.00	346.60	16.86	18.85
FEB	30.	70.	257.10	347.70	13.48	18.78
MAR	35.	65.	253.65	415.95	13.37	22.34
APL	50.	50.	193.98	454.02	10.27	24.29
MAY	55.	45.	171.05	498.55	9.11	26.60
JUN	60.	40.	147.04	500.96	7.86	26.70
JLY	60.	40.	158.91	510.69	8.48	27.24
AUG	55.	45.	183.51	486.09	9.74	25.97
SEP	50.	50.	214.19	433.81	11.29	23.27
OCT	50.	50.	252.05	417.55	13.18	22.53
NOV	45.	55.	282.31	365.69	14.70	19.86
DEC	40.	60.	331.38	338.22	17.22	18.49

TOTAL KWH USED= 2768.18
TOTAL KWH SAVED= 5115.82

MONTHLY VARIATIONS FOR YEAR 2

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	30.	70.	342.02	327.58	17.83	17.89
FEB	30.	70.	271.80	333.00	14.23	18.03
MAR	35.	65.	265.90	403.70	14.00	21.71
APL	50.	50.	201.26	446.74	10.65	23.91
MAY	55.	45.	175.54	494.06	9.35	26.36
JUN	60.	40.	149.75	498.25	8.00	26.56
JLY	60.	40.	162.33	507.27	8.66	27.05
AUG	55.	45.	189.26	480.34	10.04	25.67
SEP	50.	50.	223.39	424.61	11.76	22.80
OCT	50.	50.	264.69	404.91	13.82	21.90
NOV	45.	55.	298.97	349.03	15.54	19.02
DEC	40.	60.	349.02	320.58	18.12	17.60

TOTAL KWH USED= 2893.93
TOTAL KWH SAVED= 4990.07

MONTHLY VARIATIONS FOR YEAR 3

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	30.	70.	365.47	304.13	19.02	16.69
FEB	30.	70.	287.25	317.55	15.01	17.25
MAR	35.	65.	279.75	389.85	14.70	21.01
APL	50.	50.	208.73	439.27	11.04	23.52
MAY	55.	45.	180.40	489.20	9.60	26.11
JUN	60.	40.	152.58	495.42	8.16	26.40
JLY	60.	40.	165.92	503.68	8.85	26.86
AUG	55.	45.	195.39	474.21	10.36	25.35
SEP	50.	50.	233.19	414.81	12.26	22.30
OCT	50.	50.	278.87	390.73	14.53	21.18
NOV	45.	55.	316.98	331.02	16.44	18.12
DEC	40.	60.	376.59	293.01	19.52	16.19

TOTAL KWH USED= 3041.12
TOTAL KWH SAVED= 4842.88

MONTHLY VARIATIONS FOR YEAR 4

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COOST	SAVINGS
JAN	30.	70.	323.00	346.60	16.86	18.85
FEB	30.	70.	257.10	347.70	13.48	18.78
MAR	35.	65.	253.65	415.95	13.37	22.34
APL	50.	50.	193.98	454.02	10.27	24.29
MAY	55.	45.	171.05	498.55	9.11	26.60
JUN	60.	40.	147.04	500.96	7.86	26.70
JLY	60.	40.	158.91	510.69	8.48	27.24
AUG	55.	45.	183.51	486.09	9.74	25.97
SEP	50.	50.	214.19	433.81	11.29	23.27
OCT	50.	50.	252.05	417.55	13.18	22.53
NOV	45.	55.	282.31	365.69	14.70	19.86
DEC	40.	60.	331.38	338.22	17.22	18.49

TOTAL KWH USED= 2768.18
TOTAL KWH SAVED= 5115.82

MONTHLY VARIATIONS FOR YEAR 5

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	30.	70.	342.02	327.58	17.83	17.89
FEB	30.	70.	271.80	333.00	14.23	18.03
MAR	35.	65.	265.90	403.70	14.00	21.71
APL	50.	50.	201.26	446.74	10.65	23.91
MAY	55.	45.	175.54	494.06	9.35	26.36
JUN	60.	40.	149.75	498.25	8.00	26.56
JLY	60.	40.	162.33	507.27	8.66	27.05
AUG	55.	45.	189.26	480.34	10.04	25.67
SEP	50.	50.	223.39	424.61	11.76	22.80
OCT	50.	50.	264.69	404.91	13.82	21.90
NOV	45.	55.	298.97	349.03	15.54	19.02
DEC	40.	60.	349.02	320.58	18.12	17.60

TOTAL KWH USED= 2893.93
TOTAL KWH SAVED= 4990.07

FIRST COSTS FOR CONTROL SYSTEM

DESIGN COSTS:	168.00
EQUIPMENT COSTS:	1470.00
INSTALLATION COSTS:	420.00

TOTAL DIFFERENTIAL MAINTENANCE COSTS/YEAR: .00

CONTROL SYSTEM SALVAGE VALUE AT END OF LIFE: .00

ECONOMIC LIFE OF SYSTEM:	15.00
OVERALL INTEREST RATE:	15.00

ANNUAL ENERGY COSTS

YEAR	BASE SYSTEM	CONTROLLED SYSTEM
1	420.48	145.55
2	420.48	151.98
3	420.48	159.50
4	420.48	145.55
5	420.48	151.98
6	420.48	159.50
7	420.48	145.55
8	420.48	151.98
9	420.48	159.50
10	420.48	145.55
11	420.48	151.98
12	420.48	159.50
13	420.48	145.55
14	420.48	151.98
15	420.48	159.50

TOTAL PRESENT WORTH (PW) COSTS AND
SAVINGS INVESTMENT RATIO (SIR) AT VARIOUS DIFFERENTIAL
ENERGY RATE INCREASES:

AT .0 % INCREASE/YEAR:

PW BASE:	2458.70
PW CONTROLLED:	2945.03
SIR	.76

AT 3.0 % INCREASE/YEAR:

PW BASE:	2918.10
PW CONTROLLED:	3111.71
SIR	.91

AT 6.0 % INCREASE/YEAR:

PW BASE:	3493.74
PW CONTROLLED:	3320.67
SIR	1.08

AT 9.0 % INCREASE/YEAR:

PW BASE:	4219.32
PW CONTROLLED:	3584.20
SIR	1.31

AT 12.0 % INCREASE/YEAR:

PW BASE:	5138.38
PW CONTROLLED:	3918.18
SIR	1.59

AT 15.0 % INCREASE/YEAR:

PW BASE:	6307.20
PW CONTROLLED:	4343.15
SIR	1.95

A.5 Example 4

A fluorescent Equi-Illumination Dimming System which responds to daylight is being tested with a free standing mockup room at Lawrence Berkeley Laboratory in Berkeley California. The room is 20 feet wide (West to East dimension), 30 feet deep (North to South dimension), and 8.67 feet high. The reflectance of the ceiling, floor and walls are 80%, 20% and 50% respectively. The room was built on the top of a research building which has a gravel roof of 20% reflectance. There are three windows in the room, two of which are on the West wall, the other on the East. The window on the East wall is 28 feet long at a distance 2 feet from the floor. The two windows on the west wall are dimensioned and positioned to produce the same fenestration as on the East wall. the glass used for all windows are of 78% transmittance and 14% reflectance.

A criterion illuminance of 70 footcandles at a work plane height of 2.5 feet above the floor is desired with an assumed 5% depreciation in the maintenance factor after each year (starting at 100%). The total area is controlled at 1.8 watts per square foot. The power input vs light output relationship is linear, as shown in Figure EX4.1. The lighting system operates fro 6:00 a.m. to 5:00 p.m. five days per week. The energy rate is .06 dollars/kwh.

The daylighting values were measured at 3 times of the day on the 21st of each month for a period of a year. The times of day, % clear sky and all other input parameter are included in the listing of the input worksheet.

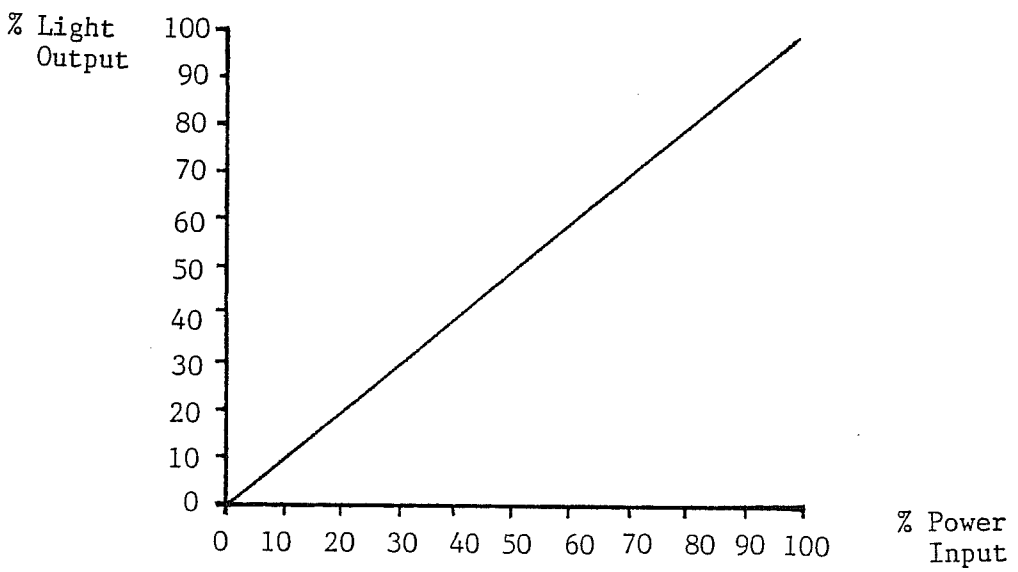


FIG. EX. 4.1 Continuous linear relationship for fluorescent dimming equipment.

QUICKLITE

QUICKLITE DAYLIGHTING ANALYSIS (X): [ ]

CONTROLITE

CONTROLITE ENERGY ANALYSIS (X): [X]

CONTROL SYSTEM SCHEDULE:

Number of Days per Week (1-7): [5]
Number of Different Daily Control Schemes (1-7): [1]

Control Scheme #1:
Number of Days per Week (1-7): [5]
Operation Hours: Start (1-24):[7] Stop (1-24):[16]
Overall Criterion Illuminance (fc): [70]
Number of Time Blocks With a Specific Illuminance (0-5): [0]

Overall Cost/Kilowatt-Hour (dollars): [.06]
Number of Time Blocks with Different Cost/KWH (0-3): [0]

CONTROL SYSTEM POWER INPUT vs. LIGHT OUTPUT DATA:

Affected Area (square feet): [600]
Control Type (X): Stepped:[ ] Continuous-Nonlinear:[ ] Continuous-Linear:[X]

Decimal Fraction Power Input: Maximum:[1] Minimum:[0]
Decimal Fraction Power Output: Maximum:[1] Minimum:[0]

DAYLIGHTING ILLUMINANCE DATA:

Daylight Analysis (X): [X]

Daylight Savings Time (X): [X]

Longitude of Site (degrees): [122]
Latitude of site (degrees): [40]
Time Zone (1-10): [8]
Decimal Fraction of Clear Sky Per Month:

January:[.5]	February:[.5]	March:[.5]
April:[.5]	May:[.5]	June:[.5]
July:[.5]	August:[.5]	September:[.5]
October:[.5]	November:[.5]	December:[.5]

Clear Sky Conditions:

Input Illuminance Values at Respective Times, for December 21:
Time: 9.02 10.34 12.05 13.37 15.08
Ill.: [29] [144] [156] [163] [165]

Input Illuminance Values at Respective Times, for January 21:
Time: 9.06 10.42 12.19 13.55 15.31
Ill.: [140] [156] [170] [176] [181]

Input Illuminance Values at Respective Times, for February 21:
Time: 8.47 10.34 12.21 14.09 15.56
Ill.: [178] [198] [211] [217] [224]

Input Illuminance Values at Respective Times, for March 21:
Time: 8.16 10.15 12.15 14.14 16.14
Ill.: [226] [250] [259] [264] [271]

Input Illuminance Values at Respective Times, for April 21:
Time: 7.40 9.53 12.06 14.19 16.32
Ill.: [269] [289] [295] [300] [312]

Input Illuminance Values at Respective Times, for May 21:
Time: 8.16 10.40 13.04 15.28 17.51
Ill.: [288] [305] [309] [313] [328]

Input Illuminance Values at Respective Times, for June 21:
Time: 8.12 10.40 13.09 15.37 18.06
Ill.: [291] [309] [312] [315] [329]

Cloudy Sky Conditions:

Input Illuminance Values at Respective Times, for December 21:
Time: 9.02 10.34 12.05 13.37 15.08
Ill.: [48] [68] [80] [86] [83]

Input Illuminance Values at Respective Times, for January 21:
Time: 9.06 10.42 12.19 13.55 15.31
Ill.: [52] [71] [87] [94] [89]

Input Illuminance Values at Respective Times, for February 21:
Time: 8.47 10.34 12.21 14.09 15.56
Ill.: [69] [77] [107] [115] [107]

Input Illuminance Values at Respective Times, for March 21:
Time: 8.16 10.15 12.15 14.14 16.14
Ill.: [96] [125] [133] [141] [133]

Input Illuminance Values at Respective Times, for April 21:
Time: 7.40 9.53 12.06 14.19 16.32
Ill.: [122] [147] [154] [165] [154]

Input Illuminance Values at Respective Times, for May 21:
Time: 8.16 10.40 13.04 15.28 17.51
Ill.: [136] [157] [168] [176] [183]

```
Input Illuminance Values at Respective Times, for June 21:
Time:   8.12     10.40     13.09     15.37     18.06
Ill.: [138  ]   [158  ]   [169  ]   [178  ]   [184  ]


ELECTRIC LIGHTING ILLUMINANCE DATA:
-----------------------------------

Maximum Conditions:       Illuminance (fc)   :[70   ]
                          Power (watts/sq.ft):[1.2  ]
Lamp and Luminaire Maintenance, and Light output Depreciation:
      Years:                1         2         3         4         5
      Maintained (X):     [ ]       [ ]       [ ]       [ ]       [ ]
Decimal Fraction of Full Light Output:
      Years:                1         2         3         4         5
      Before Maintenance:[1    ]  [.95  ]  [.90  ]  [.85  ]  [.80  ]


ECONOMIC DATA:
--------------

Control System Costs (dollars/square foot):
                      Design:                  [.0001]
                      Equipment:               [2    ]
                      Installation:            [.0001]
             Differential Annual Maintenance:[0    ]

Economic Parameters:
                      Salvage Value (dollars):[0    ]
                      Economic Life (years):  [10   ]
            Interest Rate (decimal fraction):[.1   ]


--------------------------------OUTPUT INFORMATION--------------------------------

Number of Heading Lines:            [1 ]
  # 1 [CONTROLITE DOCUMENTATION EXAMPLE #4                    ]

Output Directives (X):    Printer:[ ]          File: [X]
                                            Filename: [EXAMPLE4].LCO
```

****
CONTROLITE
****

CONTROLITE DOCUMENTATION EXAMPLE #4

CONTROLITE 1984 LAWRENCE BERKELEY LABORATORY
ONE CYCLOTRON ROAD, BERKELEY, CA 94720

DATE: 1/ 9/1985

CONTROL SYSTEM CHARACTERISTICS

CONTINUOUS DIMMING
LINEAR RELATIONSHIP:

MAXIMUM POWER(%):	100.0
MINIMUM POWER(%):	.0
MAXIMUM LIGHT(%):	100.0
MINIMUM LIGHT(%):	.0

AREA AFFECTED BY CONTROLS: 600.00 SQ. FEET

MAXIMUM ARTIFICIAL ILLUMINANCE: 70.0 FOOTCANDLES
MAXIMUM POWER INPUT: 1.2 WATTS/SQ.FT.

MAINTENANCE FACTORS
AT YEAR END:

YEAR	MF
1	1.00
2	.95
3	.90
4	.85
5	.80

NO INTERMEDIATE MAINTENANCE

BUILDING IS IN OPERATION 5 DAYS PER WEEK

FOR CONTROL SCHEME 1

CONTROL SCHEME STARTS AT 7.00 AND STOPS AT 16.00
IN EFFECT 5 DAYS PER WEEK

NET EFFECTIVE CONTROL BLOCKS SPECIFIED

START	STOP	CRITERION FC VALUE	COST/KWH
7.00	16.00	70.0	.0600

DAYLIGHTING INFORMATION

LONGITUDE OF SITE: 122.0

TIME ZONES WEST OF GREENWICH: 8

INPUT TIMES AND LIGHTING LEVELS: CLEAR SKY CONDITIONS

MONTH	SOLAR SUNRISE	TIME	FC
DEC 21	7.5	9.0	29.0
		10.6	144.0
		12.1	156.0
		13.6	163.0
		15.1	165.0
JAN 21	7.5	9.1	140.0
		10.7	156.0
		12.3	170.0
		13.9	176.0
		15.5	181.0
FEB 21	7.0	8.8	178.0
		10.6	198.0
		12.4	211.0
		14.1	217.0
		15.9	224.0
MAR 21	6.3	8.3	226.0
		10.3	250.0
		12.3	259.0
		14.2	264.0
		16.2	271.0
APR 21	5.5	7.7	269.0
		9.9	289.0
		12.1	295.0
		14.3	300.0
		16.5	312.0
MAY 21	5.9	8.3	288.0
		10.7	305.0
		13.1	309.0
		15.5	313.0
		17.9	328.0
JUN 21	5.7	8.2	291.0
		10.7	309.0
		13.2	312.0
		15.6	315.0
		18.1	329.0

INPUT TIMES AND LIGHTING LEVELS: CLOUDY SKY CONDITIONS

MONTH	SOLAR SUNRISE	TIME	FC
DEC 21	7.5	9.0	48.0
		10.6	68.0
		12.1	80.0
		13.6	86.0
		15.1	83.0
JAN 21	7.5	9.1	52.0
		10.7	71.0
		12.3	87.0
		13.9	94.0
		15.5	89.0
FEB 21	7.0	8.8	69.0
		10.6	77.0
		12.4	107.0
		14.1	115.0
		15.9	107.0
MAR 21	6.3	8.3	96.0
		10.3	125.0
		12.3	133.0
		14.2	141.0
		16.2	133.0
APR 21	5.5	7.7	122.0
		9.9	147.0
		12.1	154.0
		14.3	165.0
		16.5	154.0
MAY 21	5.9	8.3	136.0
		10.7	157.0
		13.1	168.0
		15.5	176.0
		17.9	183.0
JUN 21	5.7	8.2	138.0
		10.7	158.0
		13.2	169.0
		15.6	178.0
		18.1	184.0

ENERGY AND COST PERFORMANCE COMPARISON

MONTHLY VARIATIONS FOR YEAR 1

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	21.87	121.62	1.31	7.30
FEB	50.	50.	8.64	120.96	.52	7.26
MAR	50.	50.	2.32	141.16	.14	8.47
APL	50.	50.	.00	138.86	.00	8.33
MAY	50.	50.	.10	143.38	.01	8.60
JUN	50.	50.	.00	138.86	.00	8.33
JLY	50.	50.	.00	143.49	.00	8.61
AUG	50.	50.	.08	143.41	.00	8.60
SEP	50.	50.	.48	138.37	.03	8.30
OCT	50.	50.	6.41	137.08	.38	8.22
NOV	50.	50.	16.27	122.59	.98	7.36
DEC	50.	50.	29.10	114.39	1.75	6.86

TOTAL KWH USED= 85.27
TOTAL KWH SAVED= 1604.16

MONTHLY VARIATIONS FOR YEAR 2

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	22.25	121.23	1.34	7.27
FEB	50.	50.	8.80	120.80	.53	7.25
MAR	50.	50.	2.40	141.08	.14	8.46
APL	50.	50.	.00	138.86	.00	8.33
MAY	50.	50.	.11	143.37	.01	8.60
JUN	50.	50.	.00	138.86	.00	8.33
JLY	50.	50.	.00	143.49	.00	8.61
AUG	50.	50.	.08	143.40	.00	8.60
SEP	50.	50.	.49	138.37	.03	8.30
OCT	50.	50.	6.58	136.91	.39	8.21
NOV	50.	50.	16.50	122.36	.99	7.34
DEC	50.	50.	29.78	113.70	1.79	6.82

TOTAL KWH USED= 87.00
TOTAL KWH SAVED= 1602.43

MONTHLY VARIATIONS FOR YEAR 3

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	22.88	120.61	1.37	7.24
FEB	50.	50.	9.21	120.39	.55	7.22
MAR	50.	50.	2.54	140.95	.15	8.46
APL	50.	50.	.00	138.86	.00	8.33
MAY	50.	50.	.12	143.37	.01	8.60
JUN	50.	50.	.00	138.86	.00	8.33
JLY	50.	50.	.00	143.49	.00	8.61
AUG	50.	50.	.09	143.40	.01	8.60
SEP	50.	50.	.51	138.35	.03	8.30
OCT	50.	50.	6.93	136.56	.42	8.19
NOV	50.	50.	17.04	121.82	1.02	7.31
DEC	50.	50.	30.52	112.97	1.83	6.78

TOTAL KWH USED= 89.82
TOTAL KWH SAVED= 1599.61

MONTHLY VARIATIONS FOR YEAR 4

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	23.52	119.97	1.41	7.20
FEB	50.	50.	9.61	119.99	.58	7.20
MAR	50.	50.	2.68	140.81	.16	8.45
APL	50.	50.	.00	138.86	.00	8.33
MAY	50.	50.	.12	143.36	.01	8.60
JUN	50.	50.	.00	138.86	.00	8.33
JLY	50.	50.	.00	143.49	.00	8.61
AUG	50.	50.	.09	143.40	.01	8.60
SEP	50.	50.	.54	138.31	.03	8.30
OCT	50.	50.	7.27	136.22	.44	8.17
NOV	50.	50.	17.60	121.26	1.06	7.28
DEC	50.	50.	31.26	112.23	1.88	6.73

TOTAL KWH USED= 92.69
TOTAL KWH SAVED= 1596.74

MONTHLY VARIATIONS FOR YEAR 5

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	24.16	119.33	1.45	7.16
FEB	50.	50.	10.03	119.57	.60	7.17
MAR	50.	50.	2.83	140.66	.17	8.44
APL	50.	50.	.00	138.86	.00	8.33
MAY	50.	50.	.13	143.36	.01	8.60
JUN	50.	50.	.00	138.86	.00	8.33
JLY	50.	50.	.00	143.49	.00	8.61
AUG	50.	50.	.10	143.39	.01	8.60
SEP	50.	50.	.58	138.28	.03	8.30
OCT	50.	50.	7.63	135.86	.46	8.15
NOV	50.	50.	18.15	120.71	1.09	7.24
DEC	50.	50.	32.02	111.47	1.92	6.69

TOTAL KWH USED= 95.62
TOTAL KWH SAVED= 1593.81

FIRST COSTS FOR CONTROL SYSTEM

DESIGN COSTS:	.00
EQUIPMENT COSTS:	1200.00
INSTALLATION COSTS:	.00

TOTAL DIFFERENTIAL MAINTENANCE COSTS/YEAR: .00

CONTROL SYSTEM SALVAGE VALUE AT END OF LIFE: .00

ECONOMIC LIFE OF SYSTEM:	10.00
OVERALL INTEREST RATE:	10.00

ANNUAL ENERGY COSTS

YEAR	BASE SYSTEM	CONTROLLED SYSTEM
1	101.37	5.12
2	101.37	5.22
3	101.37	5.39
4	101.37	5.56
5	101.37	5.74
6	101.37	5.12
7	101.37	5.22
8	101.37	5.39
9	101.37	5.56
10	101.37	5.74

TOTAL PRESENT WORTH (PW) COSTS AND
SAVINGS INVESTMENT RATIO (SIR) AT VARIOUS DIFFERENTIAL
ENERGY RATE INCREASES:

AT .0 % INCREASE/YEAR:

PW BASE:	622.85
PW CONTROLLED:	1233.03
SIR	.49

AT 3.0 % INCREASE/YEAR:

PW BASE:	718.71
PW CONTROLLED:	1238.17
SIR	.57

AT 6.0 % INCREASE/YEAR:

PW BASE:	831.51
PW CONTROLLED:	1244.24
SIR	.66

AT 9.0 % INCREASE/YEAR:

PW BASE:	964.33
PW CONTROLLED:	1251.39
SIR	.76

AT 12.0 % INCREASE/YEAR:

PW BASE:	1120.76
PW CONTROLLED:	1259.82
SIR	.88

AT 15.0 % INCREASE/YEAR:

PW BASE:	1304.98
PW CONTROLLED:	1269.76
SIR	1.03

A.6 Example 5

The same mockup conditions of Example 4 are used to predict the performance of the Equi-Illumination Dimming System in this Example. The only difference being that the daylighting values are to be calculated.

QUICKLITE

QUICKLITE DAYLIGHTING ANALYSIS (X): [X]

ROOM DATA:

Dimensions (feet): Width:[20] Length:[30] Height:[8.67]
Reflectances: Ceiling:[.8] Walls: [.5] Floor: [.2]

WINDOW DATA:

Number of Windows (1-10): [3]

Window	Wall (N,E,S,W)	Distances to Sides Left	Right	Heights to Top	Bottom	Trans.	Reflec.
1	[E]	[1]	[29]	[7]	[2]	[.78]	[.14]
2	[W]	[1]	[15]	[7]	[2]	[.78]	[.14]
3	[W]	[15]	[29]	[7]	[2]	[.78]	[.14]

SKY CONDITION, TIME, LOCATION, AND SITE DATA:

Sky Type (X): Overcast:[X] Clear:[ ] Uniform:[ ]
Time: Daylight Savings Time (X): [ ]
Month (1-12):[2] Day (1-31):[25] Time (hr.min):[12.13]
Location: Longitude of Site (degrees): [122]
Latitude of Site (degrees): [40]
Time Zone (1-10): [8]
Site: Azimuth of Room (degrees): [0]
Ground Reflectance: [.2]

Explicit Solar Information (X): [ ]

ANALYSIS ARRAY DATA:

Work Plane Height:[2.5]
Number of Columns:[3] Col. #1:[5] Spacing:[5]
Number of Rows :[3] Row #1:[5] Spacing:[10]

CONTROLITE

CONTROLITE ENERGY ANALYSIS (X): [X]

CONTROL SYSTEM SCHEDULE:

Number of Days per Week (1-7): [5]

Number of Different Daily Control Schemes (1-7): [1]

Control Scheme #1:
Number of Days per Week (1-7): [5]
Operation Hours: Start (1-24):[7] Stop (1-24):[16]
Overall Criterion Illuminance (fc): [70]
Number of Time Blocks With a Specific Illuminance (1-5): [0]

Overall Cost/Kilowatt-Hour (dollars): [.06]
Number of Time Blocks with Different Cost/KWH (0-3): [0]

CONTROL SYSTEM POWER INPUT vs. LIGHT OUTPUT DATA:

Affected Area (square feet): [600]
Control Type (X): Stepped:[ ] Continuous-Nonlinear:[ ] Continuous-Linear:[X]

Decimal Fraction Power Input: Maximum:[1.] Minimum:[0]
Decimal Fraction Power Output: Maximum:[1.] Minimum:[0]

DAYLIGHTING ILLUMINANCE DATA:

Decimal Fraction of Clear Sky Per Month:

January:[.5]	February:[.5]	March:[.5]
April:[.5]	May:[.5]	June:[.5]
July:[.5]	August:[.5]	September:[.5]
October:[.5]	November:[.5]	December:[.5]

Window Activity Schedule (X): [ ]

ELECTRIC LIGHTING ILLUMINANCE DATA:

Maximum Conditions: Illuminance (fc) :[70]
Power (watts/sq.ft):[1.2]
Lamp and Luminaire Maintenance, and Light output Depreciation:

Years:	1	2	3	4	5
Maintained (X):	[ ]	[ ]	[ ]	[ ]	[ ]

Decimal Fraction of Full Light Output:

Years:	1	2	3	4	5
Before Maintenance:	[1]	[.95]	[.9]	[.85]	[.8]

ECONOMIC DATA:

Control System Costs (dollars/square foot):

```
                    Design:                 [.0001]
                    Equipment:              [2     ]
                    Installation:           [.0001]
          Differential Annual Maintenance:[0     ]

Economic Parameters:
                    Salvage Value (dollars):[0     ]
                    Economic Life (years):  [10    ]
          Interest Rate (decimal fraction):[.1    ]

--------------------------------OUTPUT INFORMATION-------------------------------

Number of Heading Lines:            [3 ]
  # 1 [CONTROLITE DOCUMENTATION EXAMPLE #5                                    ]
  # 2 [                                                                       ]
  # 3 [THIS EXAMPLE USES QUICKLITE FOR NATURAL ILLUMINANCE                    ]

Output Directives (X):    Printer:[ ]          File: [X]
                                            Filename: [EXAMPLE5].LCO
```

****
CONTROLITE
****

CONTROLITE DOCUMENTATION EXAMPLE #5

THIS EXAMPLE USES QUICKLITE FOR NATURAL ILLUMINANCE

CONTROLITE 1984 LAWRENCE BERKELEY LABORATORY
ONE CYCLOTRON ROAD, BERKELEY, CA 94720

DATE: 1/ 9/1985

CONTROL SYSTEM CHARACTERISTICS

CONTINUOUS DIMMING
LINEAR RELATIONSHIP:

MAXIMUM POWER(%):	100.0
MINIMUM POWER(%):	.0
MAXIMUM LIGHT(%):	100.0
MINIMUM LIGHT(%):	.0

AREA AFFECTED BY CONTROLS: 600.00 SQ. FEET

MAXIMUM ARTIFICIAL ILLUMINANCE: 70.0 FOOTCANDLES
MAXIMUM POWER INPUT: 1.2 WATTS/SQ.FT.

MAINTENANCE FACTORS
AT YEAR END:

YEAR	MF
1	1.00
2	.95
3	.90
4	.85
5	.80

NO INTERMEDIATE MAINTENANCE

BUILDING IS IN OPERATION 5 DAYS PER WEEK

FOR CONTROL SCHEME 1

CONTROL SCHEME STARTS AT 7.00 AND STOPS AT 16.00
IN EFFECT 5 DAYS PER WEEK

NET EFFECTIVE CONTROL BLOCKS SPECIFIED

START	STOP	CRITERION FC VALUE	COST/KWH
7.00	16.00	70.0	.0600

DAYLIGHTING INFORMATION

ROOM DIMENSIONS:

WIDTH	20.0
DEPTH	30.0
HEIGHT	8.7

ROOM REFLECTANCES:

CEILING	.80
FLOOR	.20
WALLS	.50
GROUND	.20

HEIGHT OF CALCULATION PLANE: 2.5

LATITUDE OF SITE: 40.0

LONGITUDE OF SITE: 122.0

TIME ZONES WEST OF GREENWICH: 8

INPUT TIMES AND CALCULATED LIGHTING LEVELS: CLEAR SKY CONDITIONS

MONTH	SOLAR SUNRISE	TIME	FC
DEC 21	7.5	9.0	130.2
		10.6	152.7
		12.1	164.1
		13.6	166.6
		15.1	142.0
JAN 21	7.5	9.1	143.0
		10.7	167.7
		12.3	179.8
		13.9	183.7
		15.5	155.2
FEB 21	7.0	8.8	175.4
		10.6	207.7
		12.4	220.3
		14.1	230.1
		15.9	191.3
MAR 21	6.3	8.3	213.5
		10.3	254.8
		12.3	267.3
		14.2	286.7
		16.2	237.6
APR 21	5.5	7.7	240.8
		9.9	288.4
		12.1	299.9
		14.3	328.6
		16.5	264.3
MAY 21	4.9	7.3	247.6
		9.7	303.9
		12.1	313.0
		14.5	347.9
		16.9	271.1
JUN 21	4.7	7.2	245.1
		9.7	307.7
		12.2	315.5
		14.6	352.3
		17.1	270.1

INPUT TIMES AND CALCULATED LIGHTING LEVELS: CLOUDY SKY CONDITIONS

MONTH	SOLAR SUNRISE	TIME	FC
DEC 21	7.5	9.0	50.1
		10.6	77.8
		12.1	86.4
		13.6	74.5
		15.1	44.1
JAN 21	7.5	9.1	54.7
		10.7	85.6
		12.3	95.2
		13.9	81.7
		15.5	47.5
FEB 21	7.0	8.8	65.2
		10.6	105.0
		12.4	117.8
		14.1	100.8
		15.9	57.7
MAR 21	6.3	8.3	78.7
		10.3	128.2
		12.3	144.4
		14.2	123.2
		16.2	70.0
APR 21	5.5	7.7	86.8
		9.9	145.4
		12.1	165.3
		14.3	139.9
		16.5	77.7
MAY 21	4.9	7.3	89.7
		9.7	153.9
		12.1	176.3
		14.5	148.5
		16.9	80.9
JUN 21	4.7	7.2	89.4
		9.7	155.8
		12.2	179.4
		14.6	150.5
		17.1	80.9

ENERGY AND COST PERFORMANCE COMPARISON

MONTHLY VARIATIONS FOR YEAR 1

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	22.03	121.45	1.32	7.29
FEB	50.	50.	11.16	118.44	.67	7.11
MAR	50.	50.	3.54	139.94	.21	8.40
APL	50.	50.	.40	138.45	.02	8.31
MAY	50.	50.	.00	143.49	.00	8.61
JUN	50.	50.	.01	138.84	.00	8.33
JLY	50.	50.	.01	143.48	.00	8.61
AUG	50.	50.	.05	143.44	.00	8.61
SEP	50.	50.	1.67	137.19	.10	8.23
OCT	50.	50.	8.21	135.28	.49	8.12
NOV	50.	50.	18.69	120.17	1.12	7.21
DEC	50.	50.	24.38	119.10	1.46	7.15

TOTAL KWH USED= 90.16
TOTAL KWH SAVED= 1599.27

MONTHLY VARIATIONS FOR YEAR 2

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	22.47	121.01	1.35	7.26
FEB	50.	50.	11.37	118.23	.68	7.09
MAR	50.	50.	3.66	139.82	.22	8.39
APL	50.	50.	.40	138.46	.02	8.31
MAY	50.	50.	.00	143.49	.00	8.61
JUN	50.	50.	.01	138.85	.00	8.33
JLY	50.	50.	.01	143.48	.00	8.61
AUG	50.	50.	.05	143.43	.00	8.61
SEP	50.	50.	1.70	137.16	.10	8.23
OCT	50.	50.	8.43	135.06	.51	8.10
NOV	50.	50.	18.97	119.89	1.14	7.19
DEC	50.	50.	25.13	118.36	1.51	7.10

TOTAL KWH USED= 92.19
TOTAL KWH SAVED= 1597.24

MONTHLY VARIATIONS FOR YEAR 3

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	23.21	120.28	1.39	7.22
FEB	50.	50.	11.86	117.74	.71	7.06
MAR	50.	50.	3.88	139.61	.23	8.38
APL	50.	50.	.40	138.45	.02	8.31
MAY	50.	50.	.00	143.49	.00	8.61
JUN	50.	50.	.01	138.85	.00	8.33
JLY	50.	50.	.00	143.48	.00	8.61
AUG	50.	50.	.06	143.43	.00	8.61
SEP	50.	50.	1.78	137.08	.11	8.22
OCT	50.	50.	8.87	134.62	.53	8.08
NOV	50.	50.	19.61	119.25	1.18	7.15
DEC	50.	50.	25.98	117.51	1.56	7.05

TOTAL KWH USED= 95.67
TOTAL KWH SAVED= 1593.76

MONTHLY VARIATIONS FOR YEAR 4

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	23.98	119.50	1.44	7.17
FEB	50.	50.	12.37	117.23	.74	7.03
MAR	50.	50.	4.11	139.37	.25	8.36
APL	50.	50.	.42	138.44	.03	8.31
MAY	50.	50.	.00	143.49	.00	8.61
JUN	50.	50.	.01	138.85	.00	8.33
JLY	50.	50.	.00	143.48	.00	8.61
AUG	50.	50.	.07	143.42	.00	8.61
SEP	50.	50.	1.87	136.98	.11	8.22
OCT	50.	50.	9.33	134.16	.56	8.05
NOV	50.	50.	20.28	118.58	1.22	7.11
DEC	50.	50.	26.89	116.60	1.61	7.00

TOTAL KWH USED= 99.33
TOTAL KWH SAVED= 1590.10

MONTHLY VARIATIONS FOR YEAR 5

MONTH	%CL	%CD	KWHUSED	KWHSAVED	COST	SAVINGS
JAN	50.	50.	24.75	118.74	1.48	7.12
FEB	50.	50.	12.89	116.71	.77	7.00
MAR	50.	50.	4.36	139.13	.26	8.35
APL	50.	50.	.43	138.42	.03	8.31
MAY	50.	50.	.00	143.49	.00	8.61
JUN	50.	50.	.01	138.85	.00	8.33
JLY	50.	50.	.00	143.48	.00	8.61
AUG	50.	50.	.08	143.41	.00	8.60
SEP	50.	50.	1.98	136.88	.12	8.21
OCT	50.	50.	9.79	133.69	.59	8.02
NOV	50.	50.	20.94	117.91	1.26	7.07
DEC	50.	50.	27.79	115.70	1.67	6.94

TOTAL KWH USED= 103.02
TOTAL KWH SAVED= 1586.41

FIRST COSTS FOR CONTROL SYSTEM

DESIGN COSTS:	.00
EQUIPMENT COSTS:	1200.00
INSTALLATION COSTS:	.00

TOTAL DIFFERENTIAL MAINTENANCE COSTS/YEAR: .00

CONTROL SYSTEM SALVAGE VALUE AT END OF LIFE: .00

ECONOMIC LIFE OF SYSTEM:	10.00
OVERALL INTEREST RATE:	10.00

ANNUAL ENERGY COSTS

YEAR	BASE SYSTEM	CONTROLLED SYSTEM
1	101.37	5.41
2	101.37	5.53
3	101.37	5.74
4	101.37	5.96
5	101.37	6.18
6	101.37	5.41
7	101.37	5.53
8	101.37	5.74
9	101.37	5.96
10	101.37	6.18

TOTAL PRESENT WORTH (PW) COSTS AND
SAVINGS INVESTMENT RATIO (SIR) AT VARIOUS DIFFERENTIAL
ENERGY RATE INCREASES:

AT .0 % INCREASE/YEAR:

PW BASE:	622.85
PW CONTROLLED:	1235.19
SIR	.49

AT 3.0 % INCREASE/YEAR:

PW BASE:	718.71
PW CONTROLLED:	1240.69
SIR	.57

AT 6.0 % INCREASE/YEAR:

PW BASE:	831.51
PW CONTROLLED:	1247.17
SIR	.65

AT 9.0 % INCREASE/YEAR:

PW BASE:	964.33
PW CONTROLLED:	1254.80
SIR	.76

AT 12.0 % INCREASE/YEAR:

PW BASE:	1120.76
PW CONTROLLED:	1263.81
SIR	.88

AT 15.0 % INCREASE/YEAR:

PW BASE:	1304.98
PW CONTROLLED:	1274.44
SIR	1.03

A.7 Example 6

It is of interest to determine the point by point daylighting illuminances on the work plane of the mockup room described in Example 4. The time of day is chosen to be a little after noon on February 25.

QUICKLITE

QUICKLITE DAYLIGHTING ANALYSIS (X): [X]

ROOM DATA:

Dimensions (feet): Width:[20] Length:[30] Height:[8.67]
Reflectances: Ceiling:[.8] Walls: [.5] Floor: [.2]

WINDOW DATA:

Number of Windows (1-10): [3]

Window	Wall (N,E,S,W)	Distances to Sides Left	Right	Heights to Top	Bottom	Trans.	Reflec.
1	[E]	[1]	[29]	[7]	[2]	[.78]	[.14]
2	[W]	[1]	[15]	[7]	[2]	[.78]	[.14]
3	[W]	[15]	[29]	[7]	[2]	[.78]	[.14]

SKY CONDITION, TIME, LOCATION, AND SITE DATA:

Sky Type (X): Overcast:[X] Clear:[ ] Uniform:[ ]
Time: Daylight Savings Time (X): [ ]
Month (1-12):[2] Day (1-31):[25] Time (hr.min):[12.14]
Location: Longitude of Site (degrees): [127]
Latitude of Site (degrees): [40]
Time Zone (1-10): [8]
Site: Azimuth of Room (degrees): [0]
Ground Reflectance: [.2]

Explicit Solar Information (X): [x]

Sun Position (degrees): Altitude: [ ] Azimuth: [ ]
Illuminance (fc): Direct Sun:[ ]
Overcast Sky:[ ] Clear Sky: [ ] Uniform Sky:[ ]

ANALYSIS ARRAY DATA:

Work Plane Height:[2.5]
Number of Columns:[3] Col. #1:[5] Spacing:[5]
Number of Rows :[3] Row #1:[5] Spacing:[10]

CONTROLITE

CONTROLITE ENERGY ANALYSIS (X): [ ]

```
-------------------------------OUTPUT INFORMATION-----------------------------

 Number of Heading Lines:            [3 ]
   # 1 [CONTROLITE DOCUMENTATION EXAMPLE #6                                  ]
   # 2 [                                                                     ]
   # 3 [USE OF QUICKLITE ONLY                                                ]

 Output Directives (X):    Printer:[ ]          File: [X]
                                              Filename: [EXAMPLE6].LCO
```

****
QUICKLITE
****

CONTROLITE DOCUMENTATION EXAMPLE #6

USE OF QUICKLITE ONLY

QUICKLITE 1984 LAWRENCE BERKELEY LABORATORY
ONE CYCLOTRON ROAD, BERKELEY, CA 94720

DATE: 1/10/1985

ILLUMINANCE

WORKING PLANE HEIGHT: 2.50

AVERAGE: 120.67 MINIMUM: 83.00 MAXIMUM: 148.00 MEAN DEVIATION: 22.67

ABS. Y COOR.	ABSOLUTE X-COORDINATE(S) 5.00	10.00	15.00
25.00	133.	83.	133.
15.00	146.	94.	148.
5.00	133.	83.	133.

DAYLIGHT FACTOR

WORKING PLANE HEIGHT: 2.50

AVERAGE: .09 MINIMUM: .07 MAXIMUM: .12 MEAN DEVIATION: .02

ABS. Y COOR.	ABSOLUTE X-COORDINATE(S) 5.00	10.00	15.00
25.00	.104	.065	.104
15.00	.114	.074	.116
5.00	.104	.065	.104

PERCENT SKY COMPONENT

WORKING PLANE HEIGHT: 2.50

AVERAGE: 61.50 MINIMUM: 47.01 MAXIMUM: 70.04 MEAN DEVIATION: 8.34

ABS. Y COOR.	ABSOLUTE X-COORDINATE(S) 5.00	10.00	15.00
25.00	66.68	47.01	66.73
15.00	69.69	52.95	70.04
5.00	66.68	47.01	66.73

ROOM CHARACTERISTICS

WINDOW DESCRIPTION(S):

Window	Wall	Distance To Side Right	Left	Height to Top	Bottom	Trans.	Reflec.
1	EAST	29.00	1.00	7.00	2.00	.78	.14
2	WEST	15.00	1.00	7.00	2.00	.78	.14
3	WEST	29.00	15.00	7.00	2.00	.78	.14

ROOM DIMENSIONS:

LENGTH - 30.00
WIDTH - 20.00
HEIGHT - 8.67

ROOM SURFACE REFLECTANCES:

SURFACE	REFLECTANCE
WALLS	.50
FLOOR	.20
CEILING	.80

SKY, TIME, LOCATION AND SITE CHARACTERISTICS

TIME: MONTH - 2
DAY - 25
TIME - 12.140

LOCATION: LATITUDE - 40.00

SITE: AZIMUTH OF ROOM - .00
GROUND REFLECTANCE - .20

SKY PARAMETERS:

SKY TYPE: OVERCAST

SUN POSITION: ALTITUDE - 40.10
AZIMUTH - .13

ILLUMINANCE: DIRECT - 5104.74
OVERCAST SKY - 1285.28
CLEAR SKY - 1312.46
UNIFORM SKY - 1285.28

Appendix B: Notes for Hard Disk Users

CONTROLITE has been designed to run most conveniently on an IBM/PC system that includes a hard disk. Under such an arrangement, most of the user prompts have been eliminated so that the system will run from the Activity Menu to printed output with the fewest amount of interruptions. Additionally, the user is permitted to submit more than one input file for batch execution at any one time. Calculations and output can then be produced for each of these files while the computer is left unattended.

In the main text of this manual, only aspects of the dual floppy disk version are discussed. This section provides information on the differences that exist between the hard disk and floppy disk versions. These differences appear in both the set-up and the running of the program. The discussion presented herein is for a hard disk system that is assumed to be operating under DOS 2.0.

1.0 Set-Up

The recommended arrangement for storing the CONTROLITE programs, data base files, and scratch files is one of the simplest methods possible. This involves placing all of the analysis programs into a single directory on the hard disk. All input files, error files, output files, and data base files are stored on a separate directory.

To set-up the analysis programs in their own directory, which is assumed to be named CONTROL, you will need to do the following:

Step 1: With the computer at the C> prompt, initialize directory CONTROL by typing "MKDIR \CONTROL".

Step 2: Successively insert each of the CONTROLITE diskettes into drive A, and type "COPY A:*.* C:\CONTROL".

In order for the programs to function properly, it is also necessary that the DOS file COMMAND.COM and ASSIGN.COM be stored on the root directory, or main directory, of the hard disk. With the DOS diskette in drive A, type "COPY A:COMMAND.COM C:\" and "COPY A:ASSIGN.COM C:\".

It is also necessary to copy three additional files to the directory in which the data files and luminaire files will reside. Assuming that this directory is named "RUNDATA", and that all of the CONTROLITE diskettes have been copied onto the hard disk as instructed above, the following commands will copy the necessary files to this directory: "COPY \CONTROL\LUMEN-C.BAT \RUNDATA"; "COPY \CONTROL\HARDDISK \RUNDATA"; and "COPY \CONTROL\LUMENC.PAS \RUNDATA".

After all files have been copied to their respective directories, the installation of CONTROLITE on the hard disk is complete.

Each time you wish to run CONTROLITE, certain system parameters must be set in order to direct the program to the RUNDATA and CONTROL directories. Once set, the program can be run any number of times until the computer system is reset (by turning the power off or executing a [Ctrl]-[Alt]-[Del]) or until any of these parameters are altered. This means that each time you turn on your computer, you will need to set these parameters before you can run CONTROLITE . Also, if your computer is already on and you are working on some other program on your system, you will need to reset these parameters before running CONTROLITE. The commands that must be executed to set the appropriate system parameters are the following:

```
C>\ASSIGN B=C
C>PATH \CONTROL
C>CD \RUNDATA
```

It may be convenient to store these commands in a batch file on the root directory of the hard disk. When you want to set up the system to run CONTROLITE , you then just execute this batch file.

The arrangement recommended for storing the analysis programs and data files on your hard disk is probably the most convenient and most organized arrangement possible. For special applications, your system can be configured differently, but this requires a thorough understanding of DOS and its tree structured directories.

The following information may be helpful in designing a different arrangement if one is required.

1) All scratch files, error files, and output files are written to drive B (unless drive B is assigned otherwise).

2) Data base files, when they are initialized, are done so on drive B (unless drive B is assigned otherwise).

3) All files that are rewritten or initialized on the hard disk will be written to the current directory.

4) All files that are executed during a CONTROLITE analysis run, if not in the current directory, must be in one of the directories specified under the PATH command.

Assistance with specific hard disk configurations can be arranged on an individual basis by calling Lighting Technologies.

IMPORTANT: For a hard disk system, the files which reside on the Data Input diskette must be copied into the appropriate directory using "COPY *.*" as with all of the other system files. However,

one of the copies of the Data Input diskette supplied by Lighting Technologies must be in drive A at all times for the system to operate properly. Drive A must not be assigned to any other drive designation. Be sure that COMMAND.COM has been copied to the Data Input diskette which is being used. When you go to run CONTROLITE, you should be at the "C>" prompt when the "LUMEN-C" command is issued.

2.0 Running CONTROLITE (Hard Disk Version)

The main difference between running a hard disk version and a dual floppy disk version of CONTROLITE involve a few extra and a few missing options in Activity Menu #8. Upon selecting this activity, the following prompt will appear:

```
Number of runs   [  ]
```

This prompt does not appear in the dual floppy version because only single runs are permitted under that system. Up to 33 consecutive runs can be submitted.

For each input file to be submitted, the following prompts will appear as in the dual floppy version:

```
Input File Name #1  [        ].LCI
Error File Name #1  [        ].ERR
```

Entering a "1" in the cell for the number of files to be submitted will cause the program which performs the error checking to operate in the same manner as in the dual floppy version, except that the prompts to insert the photometric data base diskettes have been removed since the program assumes that all of the photometric information needed resides on the hard disk.

Upon successful completion of the error checking program, the program will ask if the user would like to continue and run CONTROLITE. For an unsuccessful check of the input file, the user will be returned to the Activity Menu, as before.

If the number of input files to be submitted is greater than one, this program behaves in a very different manner. This multiple run option is intended for use with input files that have previously been checked and have been found to be error free. Error checking on these files is still performed, but only with the default screen display options ("Do not print all lines" and "Do not print print any error messages"). If a file is found to contain an error, execution of that input file will be terminated, and error checking will begin on the next input file specified.

Since the files in a multiple run should have already been checked for errors, error files should not be necessary.

Omitting the error files speeds up the execution of the data checking program and eliminates the creation of any additional files on the hard disk. Error files may still be declared for any or all of the input files specified, however the files should be unique for each input file since any existing error file of the name given will be overwritten each time the data checking program is executed.

Successful completion of this program in a multiple run case will cause the calculation programs to begin without the need for any user input.

Note: In either the single or the multiple run case, the calculation programs and output routines are executed without any prompts or pauses. It is therefore important that the printer be turned on when the run is initiated if hard copy printout has been selected as one of the output options.